THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXIII. No. 1885.] LONDON, JUNE 27, 1899. [51ST YEAR. PRICE 6d.

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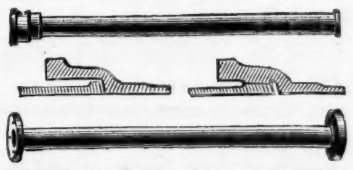

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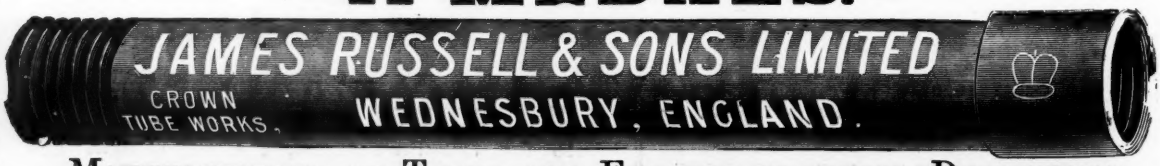

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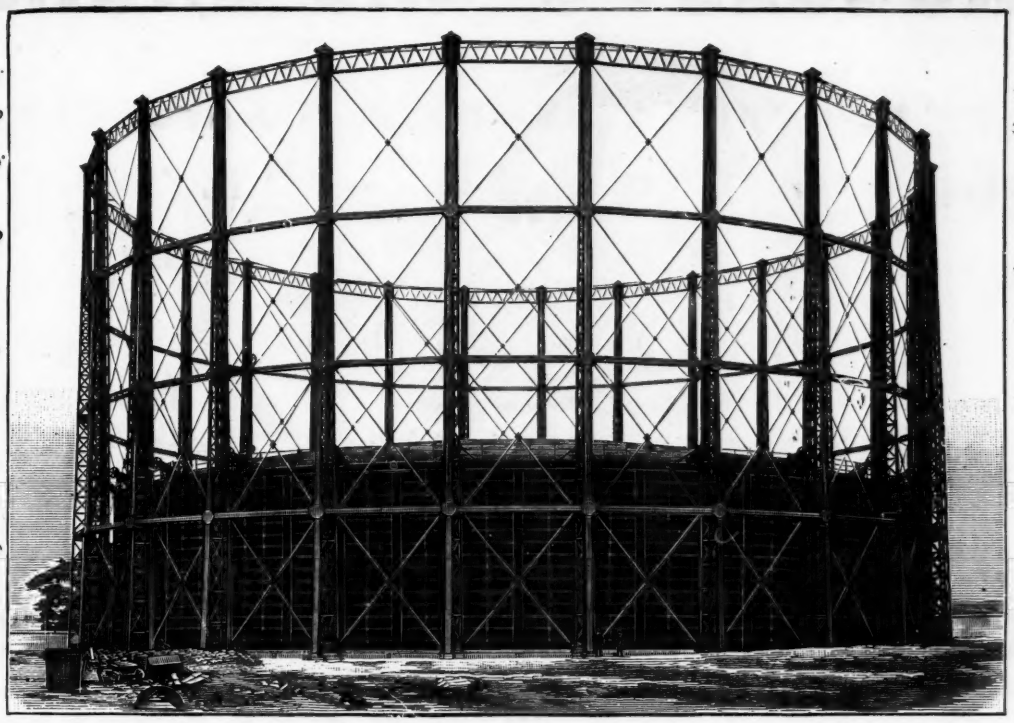

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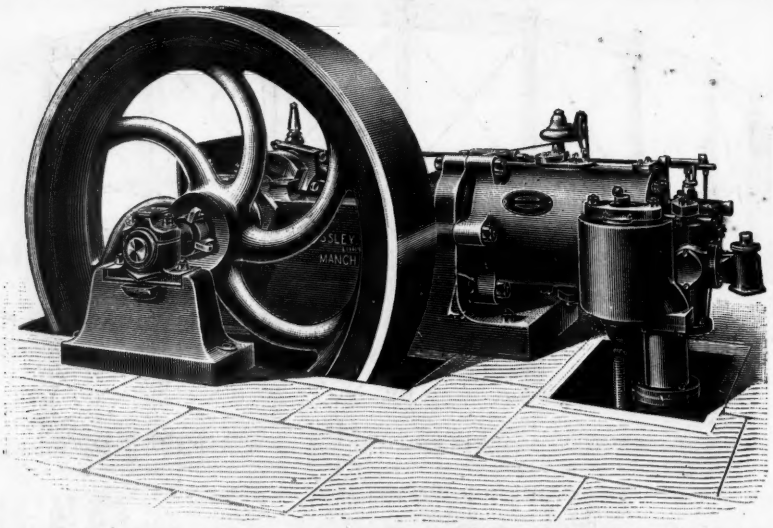

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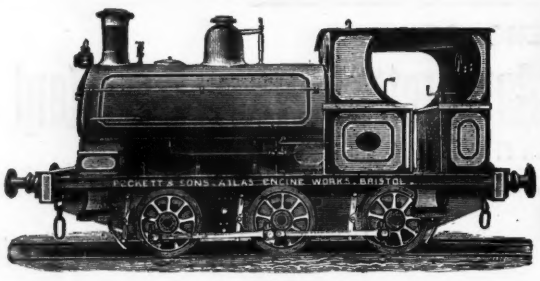

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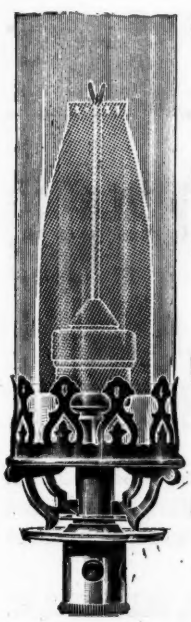

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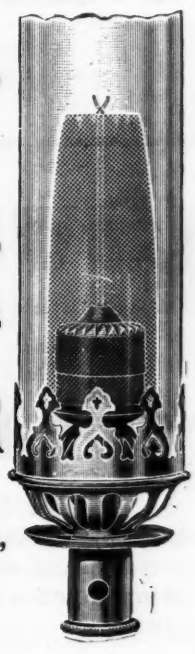

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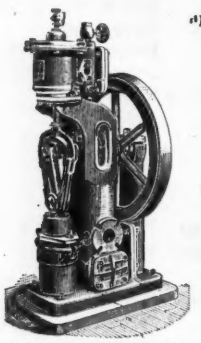

"Fig. 705. SINGLE RAM" STEAM-PUMP.

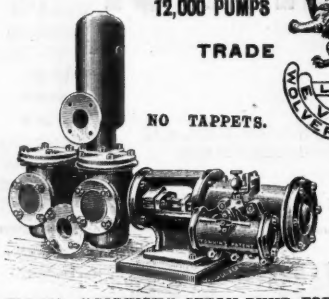

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

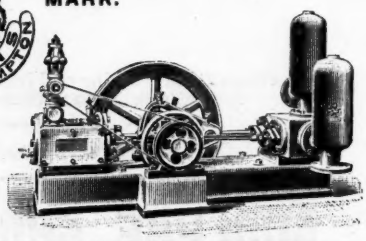

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

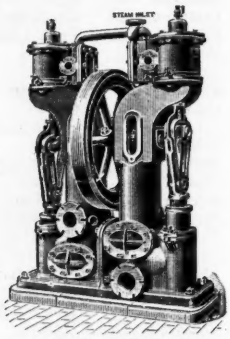

Fig. 712 "DOUBLE-RAM" STEAM-PUMP.

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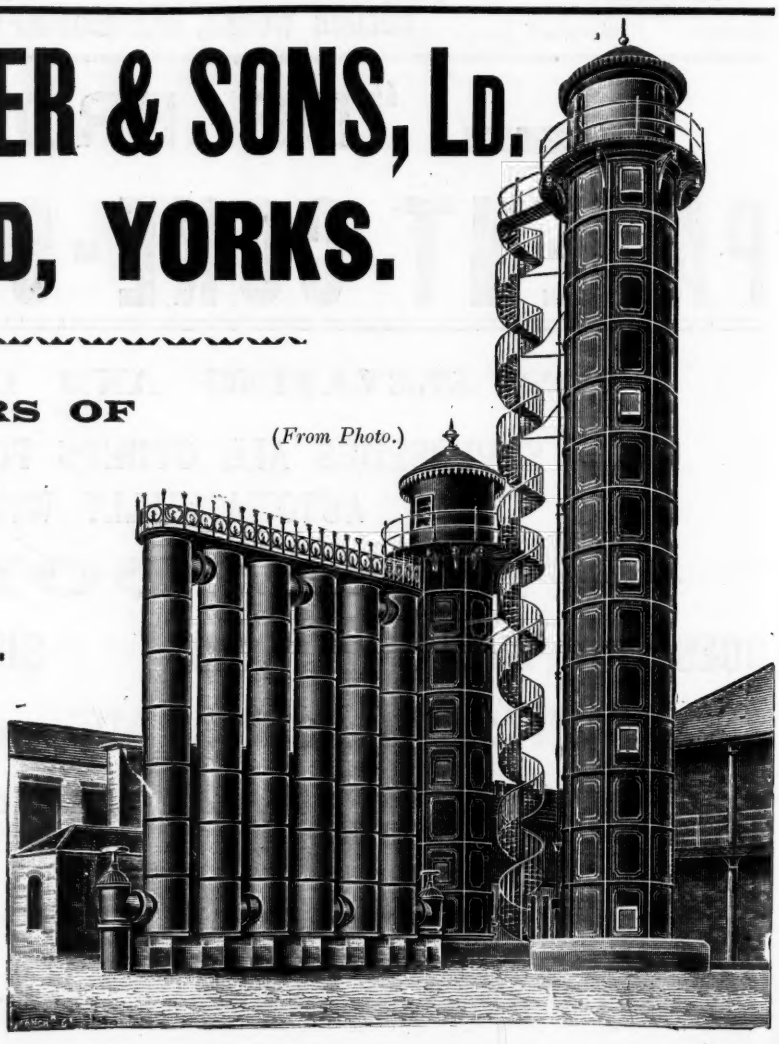

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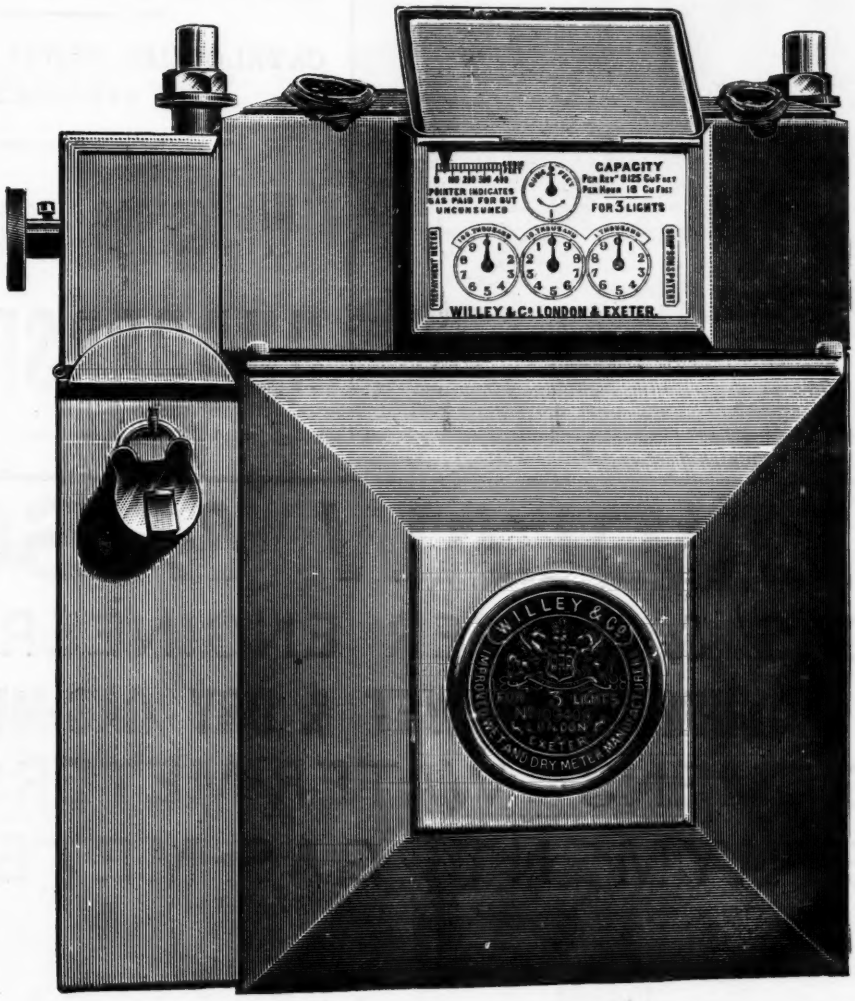

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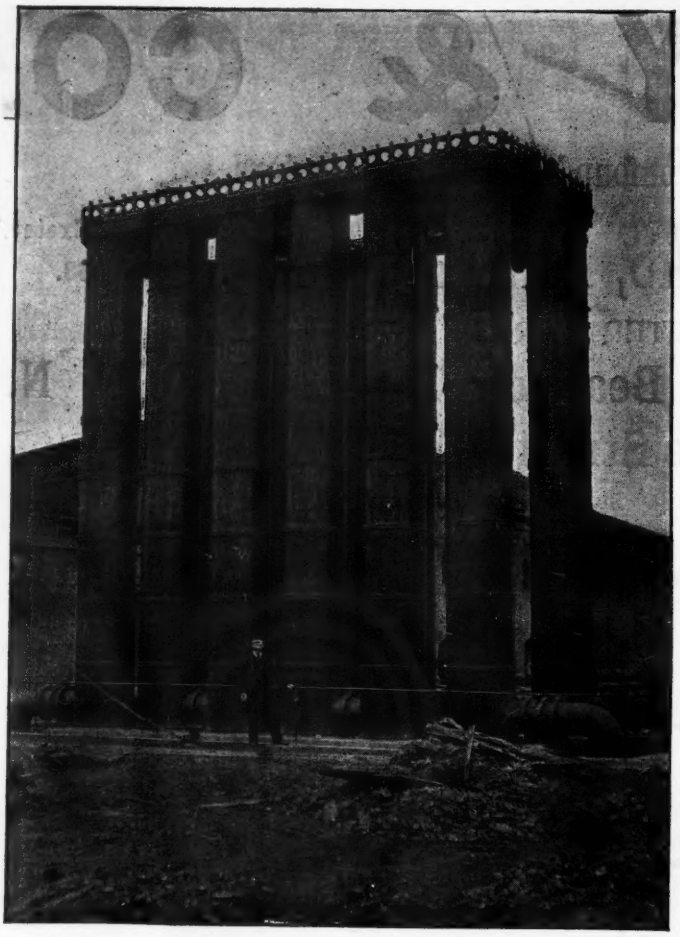

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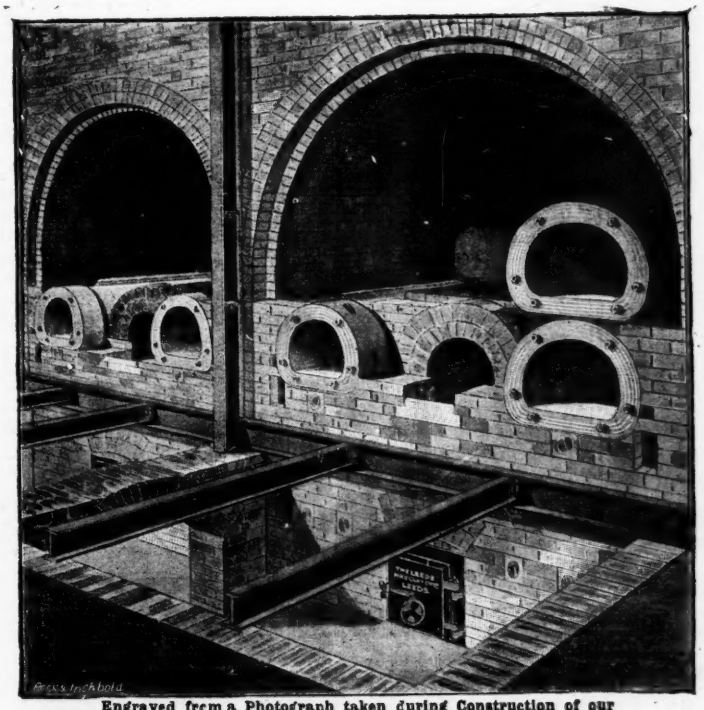

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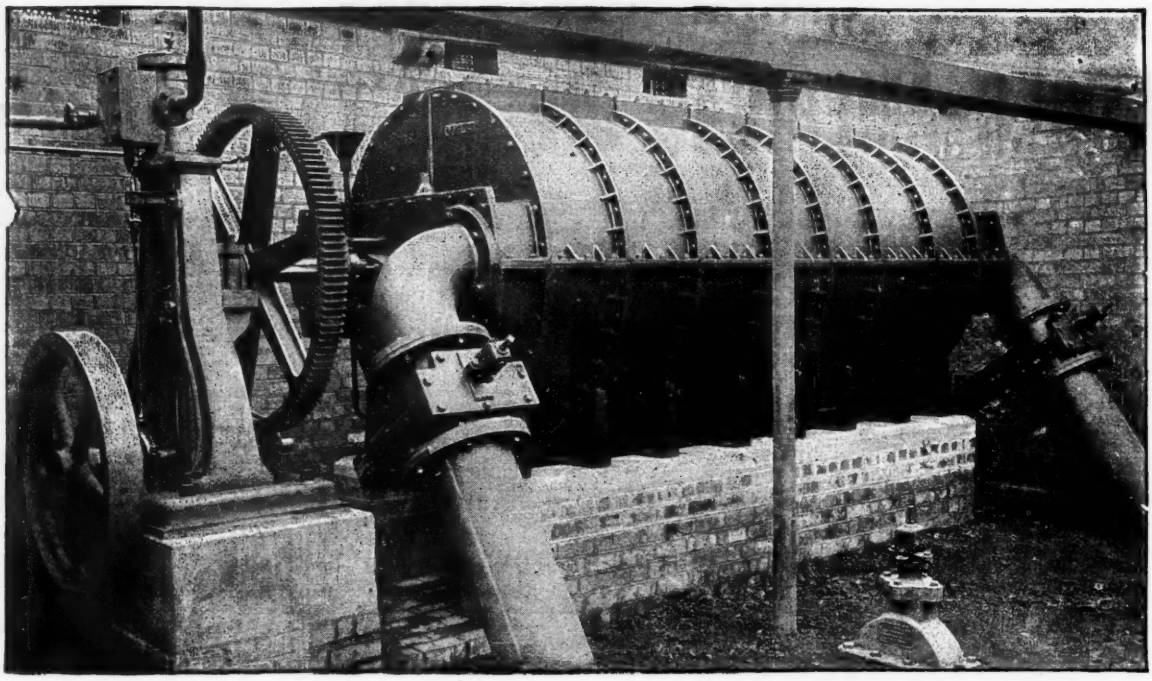

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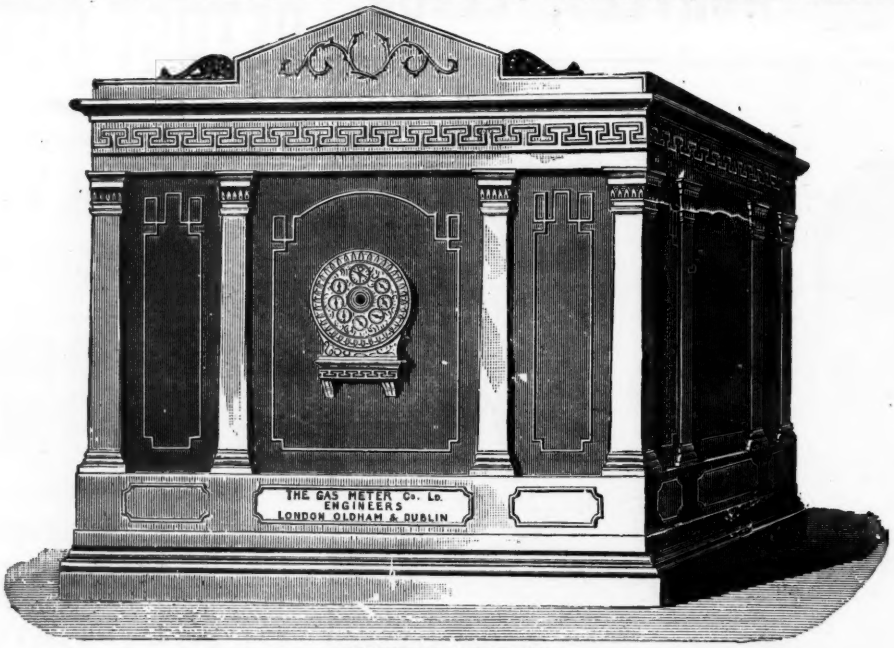

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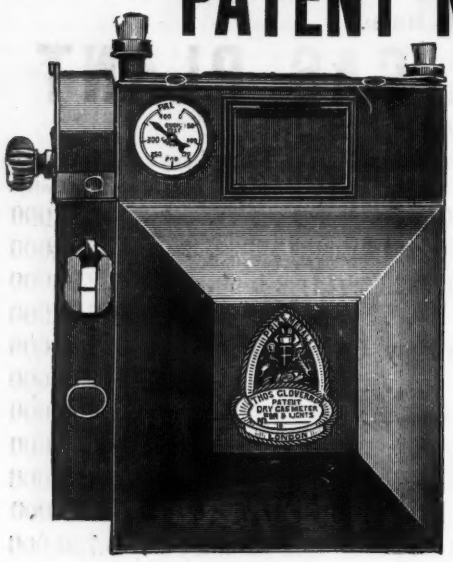

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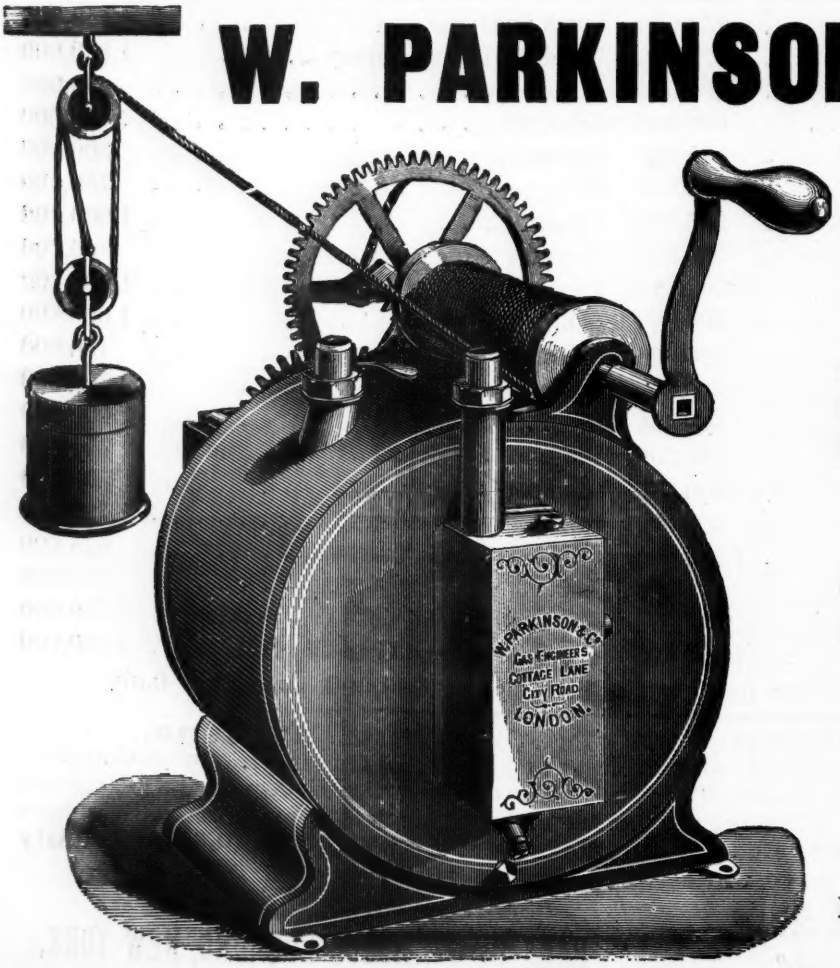

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EDITORIAL NOTES.

Differential Prices for Gas and Electricity.

THE interesting questions as to the fairness and the expediency of differential charges for gas sold for different purposes, raised by Mr. Thomas Newbigging at the meeting of the Gas Institute, were not exhausted either by the paper or the discussion upon it. This subject is as familiar to the managers of electricity supply undertakings as it is to gas managers; and it would not be a bad topic for discussing at a joint conference of representatives of the two industries. It is rather a remarkable illustration of the tendency of electrical engineering opinion in this regard, that two or three applicant Companies for competing Orders for the City of London offered electricity for power purposes at about one-half of the standard charge for lighting current. The successful Company offer to furnish current for these purposes as low as 2d. per unit. This is a very serious matter for gas companies subjected to this kind of competition; and the right way of dealing with it is not to be settled off-hand, without regard to all the considerations involved. The idea of a uniform price for any commodity, subject only to a trade discount, or to discounts for cash or for taking a large quantity, is the natural one. The very first glance at the "accidents" and conditions of the trade in particular commodities, however, generally reveals qualifying considerations which encourage variation of the simple rule of "One Price." There are very few trades indeed in which the tradesman could not say that if his customers would only shape their demands differently, he could afford to make them a substantial reduction of price. Wherever such a consideration offers itself, there is the inducement to make a difference in the charge to suit the circumstances.

The case of gas or of electricity supply does not seem to differ from that of any other commodity in this particular respect. Uniformity is the normal state of things, every departure from which is to be justified by showing cause. Of course, this justification may exist in some instances, and not in others. Places and circumstances both vary. What the administrators of supply undertakings have to guard against is the irrational application to one place of a system of differential charges which may answer very well elsewhere; and also the unfounded prejudice in favour of making differences for the sake of the name. We may be wrong; but it is our belief that the fashion of electricians in marking down the price of current sold for "power "purposes" to one-half that of the lighting current, is a mistake. Their object in so doing is to rival the gas-engine and the hydraulic power motor, especially in such a place as the City of London; but they do not stand to gain anything by it. If the gas company were to copy their tactics, and supply gas-engines at half rates, where would they be? This is done in some places, for reasons good, bad, and indifferent; but the objection to everything of the kind is contained in one word—"overlapping."

The advantage of selling gas at a specially low rate for fuel and power purposes arises out of the idea of "day "gas," as the Continental gas-works administrators called it. Their notion was that whatever went to equalize the output over the twenty-four hours was so much to the good of the undertaking, that the public might very fairly have a large share of the benefit of it. This is perfectly reasonable; but few gas undertakings have found it worth while to work their business on a daily time schedule. Even so, there would be no guarantee that on occasions in the depth of winter the artificially-fostered day business would not be a source of trouble. Overlapping again! This is, indeed, the first and the last word on the whole question. The electricity supply undertakers who are competing for custom in densely populated cities by serving motors at half price, are acting very foolishly. The public need not think that gas companies are at all likely to follow their example. But they only make the offer because there is little or no trade to be had at any price. If there were much of it, they would be more careful how they laid themselves out for making troublesome and unprofitable connections. The experience of the London Electric Cab Company is instructive upon this head. They wanted a good deal of current for charging their batteries; and the London Electric Supply Corporation agreed to let them have it at a special reduction. But the supply was subject to so many restrictions as to time and place, in order to

keep it from overlapping the ordinary business, that both parties grew sick of it, and dropped the connection. Now the Cab Company make their own current at a cost of about 2d. per unit. Anybody else can do the same, by using a gas-engine charged for at the ordinary rate. The consumer can run his engine during the busiest lighting hours, if he likes, without feeling under any obligation to the gas company for the privilege. It is all included in the price of the gas. But the mere fact of his doing so ought to convince any reasonable business man that he has no claim to any special consideration.

The Bristol Gas Bill—Another Precedent.

THE Bristol Gas Company have had a stormy time in Parliament this year. Whatever may be said for and against Progressive (or aggressive) Municipalism in the abstract, it is abundantly evident that statutory supply companies find it increasingly difficult to live with local authorities in the concrete. Also, while Parliament has been awakened to a sense of the risk of permitting Municipalities to indefinitely enlarge their trading operations, statutory Companies are kept within equally close bounds. Thus, one thing the Bristol Gas Company originally desired was power to hire out dynamos in connection with gas-engines; but the Corporation, having an electric lighting undertaking, very naturally opposed the application. The Lords Committee accordingly struck it out. As the amended Bill came before the Commons Committee, it contained a clause designed to modify the terms for street lighting. Under the existing legislation, the Company are bound by the very general requirement not to charge the Corporation a higher price for gas supplied to the street lamps than the lowest rate paid for the time being by any private consumer. The Company, however, wished to be enabled to make special terms with consumers of gas for purposes other than lighting; and they did not desire that the terms of any agreement to this effect should govern the price of gas for the public lamps. The Corporation do the same thing in their electricity supply business; selling current for power at 1½d. per unit, whereas they would not think of charging so little for any lighting service. In the event, the Committee refused to disturb the existing arrangement. The question of differential charges for gas and electricity is discussed in another paragraph, and so need not be dealt with, as a matter of principle, here.

The point of most general interest in these Committee proceedings was the treatment of the extraordinary proposals of the Bill giving the Company powers over consumers' internal fittings. The clause was published in full in our customary abstract of the Gas Bills for the year (*ante*, p. 125). That the powers asked for would be likely to inure to the public advantage is as obvious as the other fact—that no such salutary provision exists in any Gas Act. It was to have been expected that so strong a precedent would not be set without the highest authorities having something to say to it. The matter was remitted to the Home Secretary, who reported upon the proposals of the Company in the sense recorded in another column. On the whole, the official view of the novel clause was favourable; and, as the result, Bristol once more strikes out a fresh line in gas legislation. This is one of the most important features of the parliamentary work of the year.

The Metropolitan Gas Companies (Powers of Charge) Committee.

THE time of this Committee was mainly occupied last week with hearing the continuation of Mr. J. W. Field's evidence. The witness had a good deal to say about the severity of the electric light competition in the district of The Gaslight and Coke Company, which was not altogether reminiscent of the Governor's recorded remarks about the state of the Company's business in the "Bond Street quadrilateral." He spoke of the cost of coal lighterage to the Company, and claimed that the enrichment of the Company's gas is higher than that of the South Metropolitan Company's gas. Mr. Field traversed many of the statements of previous witnesses, and repeated several of the familiar points of the famous "Reply" of his Board to Mr. Livesey's strictures. He asserted that not only is there no ground for the charges of extravagance and mismanagement which have been brought against his Company, but that, as a matter of fact, the Company have actually done better than their neighbours. It was not a very generous thought to drag the Crystal Palace District Company into the comparison, assuming Mr. Field's knowledge of the circumstances to be complete; while others, to whom the recent proceedings of the Company in question are no secret, might very easily cap Mr. Field's reference in a manner that would be more pointed than pleasant. Mr. Field did not complete his evidence on Friday, reserving the rest of his reply to Mr. Livesey for to-day. He was followed by Mr. G. F. L. Foulger, who explained to the Committee the exceptionally onerous character of the work of gas distribution in the Company's area; and declared that the price of gas had nothing to do with the vogue of electric lighting in the best neighbourhoods. Mr. Foulger repeated the allegation that the manner in which the South Metropolitan Company work their automatic meter supplies is disadvantageous to the consumer. Mr. G. C. Trewby also gave evidence contradicting in various respects the criticisms of both Mr. Livesey and Mr. Hunt. The Chairman has expressed the hope that The Gaslight and Coke Company's evidence will be finished at to-day's sitting. It is possible that after this Mr. Haward may be recalled, for the London County Council; but there cannot be much more to say on the simple facts of the prices of gas in London.

Mr. Littler on Private Bill Procedure.

MR. R. M. LITTLER has unburdened his soul respecting the defects of the Government Bill for altering Private Bill Procedure for Scotland. This measure is being forced through the House of Commons by the use of the Government majority; but the leader of the Parliamentary Bar denounces it, root and branch, as unnecessary, uncalled for, and mischievous. Of course, criticism like this from such a quarter is open to the objection that it may be interested; but, as Mr. Littler remarks, in frankly recognizing the objection, the matter can only concern him now for a very few years. His position and experience entitle him to speak upon the subject with authority. While condemning the Scotch Bill, Mr. Littler makes some valuable observations upon the general system of Private Bill legislation. He admits that there are evils, but thinks they might be removed without imperilling a system which is without equal for its object. Very large sums could be saved by merely a moderate reform of the Standing Orders. Although the tribunal at Westminster is unpaid, the cost of the procedure is enormous. In fees alone, the nation makes a profit of £50,000 a year. In addition to this excessive charge, which might be abolished to-morrow, "if the useless waste in unnecessary advertising, "&c., were abolished, and if 'deputations' would moderate "their numbers and curtail their expenses while in London, "the present system would be one without equal for accom- "plishing its object. The costs otherwise in Parliament "compare most favourably with those in any other important "classes of litigation; while the tribunal is in every way fit "for its task." Moreover, the use of Committees to members themselves is great; and a distinguished Minister of Cabinet rank has confessed that "but for experience on "Private Bill Committees he would never have been where "he is." Truly, the reform of Private Bill procedure in any important respect is a very perilous undertaking, not to be adventured upon lightly.

The British Workman's Thrift.

THE occasion of the laying the foundation stone of the new Post Office Savings Bank at West Kensington on Saturday was fraught with profound significance for all observers of the social condition of the people of England. Since its establishment in 1861, the growth of the Post Office Savings Bank has been one of the soundest evidences of the advancing well-being of the great mass of the population of this country. It is impossible to reconcile this rapid expansion of the Government Bank with the oft-repeated socialistic allegation that under the existing economic system the rich become richer and the poor poorer. On the contrary, the Bank, with its agencies at every man's door, has proved to be a powerful incentive to the formation of that habit of thrift which professional Socialists, with good reason, vilify as the greatest obstacle to the propagation of their opinions. Actually, according to the report of the Postmaster-General, there are 8 million depositors in the Post Office Savings Bank, with a balance to their credit of £123,000,000. One out of every five persons in the United Kingdom is now a depositor; and about four-fifths of the depositors belong to the wage-earning classes. As everybody knows, the way is easy for depositors to buy Government stock, to insure their lives, and to obtain annuities. When one remembers that the Post Office Savings Bank is only one of many institutions for dealing with the economies of the people, it seems pretty evident that there must be in general a considerable margin between wages taken and the prime necessities of the wage-earners for maintenance. Yet the average British

workmen is a long way from being a thrifty individual; and there is no immediate danger of his falling into the miserly way of living denounced by his Socialist counsellors as altogether inseparable from the practice of the rule of thrift. Marvellous and almost incredible as the truth is to those Political Economists who have never learnt to distinguish between rates of wages and actual weekly earnings, the English mechanic is rarely as eager to earn the utmost possible amount of money for himself as his employer is willing to pay it for work done. Not long ago, the "Daily "News" was quite surprised to learn that the shipbuilding hands on the east coast and elsewhere, where trade is brisk, could not be induced to work more than four days a week. Their piece-work money was too good for them. The men could easily make as much as they knew how to spend reasonably, and more, in little more than one-half the time the yards were open. This is the answer to those who contend, with most Trade Unions, that rates of wages are everything to workpeople. Unless the man is thrifty by nature or education, high wages may, and probably will, be his greatest curse. There are no working-class homes so wretched as those of the over-paid. Here comes in the real merit of profit-sharing, Post Office banking, and all the other encouragements to working men to make the best use of their working time. The man who has a banking account of his own, in any form, is not likely to squander his earnings in betting and debauchery. The low-class political clubs will not make his Day of Rest a mockery. Like Longfellow's Village Blacksmith, he "earns whate'er he can;" and the more money he has to touch on pay-day, the better is his employer pleased.

London Lamp Accidents in 1898.

Whether the Petroleum Acts are to be amended this session or not, the London County Council are not letting the vexed question of the cause of lamp accidents drop out of notice. The Public Control Committee of this body have reported that during the year ending March 31 they investigated the circumstances of 304 petroleum lamp accidents which occurred in London during this period. Twenty-eight of these accidents had fatal results; while the remaining 276 caused fires to which the Fire Brigade were called, and thus became public. The Committee found that 39 accidents were veritable lamp explosions; the rest being cases of the ignition of the oil, which in the great majority of instances escaped through breakage of the reservoir. There being a strong inducement to convert these not highly alarming statistics into evidence in support of the previous declaration of the County Council in favour of the raising of the flash-point of lamp oil, the Committee observe that as neither explosion nor sudden ignition usually takes place until the temperature of the oil has reached or passed its flashing-point, they attach the greatest importance to the raising of the statutory test to a point higher than the temperature attained by the oil in the reservoirs of lamps while burning. Inasmuch as it is clear, from numerous experiments, that the temperature of 100° Fahr. is rarely reached by petroleum oil while being burnt in lamps, the Committee believe that if no oil with a lower flash-point were used for illuminating purposes the great bulk of the accidents which now occur with lamps would cease. They are also of opinion that if only lamps of safe construction were used, the number of accidents would be largely diminished; but they realize that it would be impossible for any legislation to touch the immense number of lamps now in nightly use, or to prevent neglect and carelessness in the use of lamps originally safe. On the other hand, raising the flash-point is commended as a very effective and easy way of obtaining security. This language is what might have been expected.

When Parliament is asked to dislocate an enormous industry in the alleged interest of public safety, on the faith of certain evidence, this evidence cannot be too carefully weighed and tested. Above all, it should be divested of all comment inspired by prejudice. One might well ask whether, if the Public Control Committee of the London County Council had not previously made up their minds in favour of a flash-point of 100° or 105° for lamp oil, the figures and facts of their last report would have been held sufficient to support such a contention. To hear all the ravings about the "deadly low-flash oil," one would think that lamp explosions directly traceable to this cause occurred by the hundred. But instead, the Committee can only find 39 for all London for the past year, and 265 oil-fires which they think had some connection with the same characteristic of the oil. Of course, even 39 deaths from a strictly preventable cause are too many. There have not been so many fatalities from the wrongful use of aconitine and other alkaloid poisons since the discovery of these drugs; and yet they are rightly kept out of people's reach. Accidental deaths from drinking carbolic acid are far more numerous; yet this preparation is too useful to be forbidden. The case against lamp oil which the London County Council seek to make out is weak in several places; and the boon to the public of a cheap and plentiful supply of petroleum is too great to be sacrificed for a preconceived idea.

WATER AND SANITARY AFFAIRS.

The Governor of the Chelsea Water Company (Mr. F. S. Clayton) had not a very long story to tell the proprietors at their meeting last Thursday; but it was a satisfactory one. The whole of the Company's district has been placed under constant supply; and it is being systematically inspected with the view of detecting and checking waste. Half of the services are at present under control by the Deacon waste-meter system; and in course of time the entire area will be included. Desirous, on the one hand, that the consumers should have an uninterrupted supply, the Directors are careful on the other, that it shall be properly regulated. The result of their labours in this direction will probably be a very material reduction of the prescribed daily quantity of 35 gallons per head. While attention is being given to the distributing arrangements, important storage and filtration works are in progress. The new service reservoir now in course of construction at Putney Heath will give the Company storage to the extent of 22 million gallons; while the enlargement of the subsidence reservoirs at West Molesey will allow of a larger quantity of the raw water being collected prior to undergoing the filtering process. The Directors are carrying out the policy advocated at the recent Engineering Conference, of having adequate subsiding and filtration plant; and its wisdom cannot be too frequently emphasized. These works have necessarily involved considerable expenditure—close upon £80,000; but the Company have no difficulty in raising money. Whatever opinion is held in some quarters as to the undertaking, investors evidently have confidence in it, for a recent issue of capital was placed at £2 premium on each £1 share; thus producing a large amount of money available for the business, while only one-third of it will bear interest. The Governor was perfectly justified, therefore, in saying that, so far as financial affairs went, the Company were in "comfortable circumstances;" and as the Directors recommended the continuance of the dividend at the rate of 11 per cent. per annum declared at the previous meeting, the proprietors would scarcely be inclined to question the statement. Of course, Mr. Clayton could not give them any forecast of the terms of the report of the Royal Commission. He could only assure them—though the assurance was hardly necessary—that, whether the Company were allowed to go on or their undertaking was acquired by some public body, the Directors would do their best both for the consumers and those who had invested their money in it. The future of the water undertakings cannot be foretold. The Water Committee of the London County Council have, however, already given an indication of what they consider should be done next session; and at the meeting of the Council to-day they will ask for authority to expend £3000 in making the necessary preparations to proceed with Bills dealing with the London Water Supply, should this course be decided upon in November.

It was not to be supposed that the spell of hot and dry weather through which we have lately passed would not be seized upon by writers in a certain section of the Press as a good opportunity to raise once more the cry of "Water "Famine." But the East-end consumers need be under no grave apprehension in this regard. It was shown last week that certainly two of the London Water Companies are in a position to render aid to the East London Company should they require it; and the writers in question are compelled to acknowledge that the intercommunication scheme is an accomplished fact. But it is said the consumers are by no means sanguine as to how it will work; and insinuations are thrown out to the effect that the East London Company would not avail themselves of the assistance placed at their disposal. It matters little what the Companies do—whether they link up their systems or do not—they come in for some adverse criticism. Only a few weeks ago, when the hot weather came in suddenly,

the Grand Junction Company, as the Chairman told the proprietors at the recent meeting, increased their daily supply from 18 to 24½ million gallons; while on one day, in order that the consumers should not be in any way restricted, 25 million gallons were delivered. He contrasted this with the state of affairs in Birmingham, where restrictions had been imposed in respect of the use of water for gardens and sprinkling lawns, and where fears were entertained that it would be necessary to curtail the supply for domestic purposes.

From Birmingham let us turn to Paris. According to the correspondent of a London evening paper, after barely a week of hot weather the Parisians received an intimation that the supply of water would be cut off from nine in the evening till five in the morning, "until such time as "problematical rains shall have replenished the reservoirs "which the authorities are paid to fill, and which are "always empty on the least emergency." This is bad; but there is probably something worse behind. The experienced Parisian knows that, after a brief interval, the first official intimation is followed by a second, announcing that the supply of spring water has become wholly inadequate, and has to be eked out by letting into the pipes what the writer above referred to characterized as "the "solution of sewage that does duty for water in the Seine." We have it on good authority that many things are ordered better in France than in this country; but water supply does not appear to be one of them, for we are told that "Parisian water is, year in, year out, a drink that can "only be ventured upon with the gravest apprehension." It would be interesting to know how such stuff would figure under the bacterioscopic examination to which London water is subjected day after day by the eminent Chemists entrusted with this work. We are afraid that it would not contrast very favourably with it. Yet the Parisian appears to pay for his water willingly, while the Londoner, as a general rule, does so with grumbling, although the commodity supplied to him is of much better quality than that served out to his neighbour across the Channel. And in order that there shall be no deterioration, increased vigilance is being shown by the gentlemen above alluded to. Sir William Crookes and Professor Dewar state, in their last monthly report to the Official Water Examiner, that they increased by 26 the number of samples of water analyzed in May—bringing it up to 208; while they examined bacterioscopically 422 samples, against an average of 292 in former months. By the new arrangement, it is believed that the whole of the water supply of the Metropolis is now substantially under examination as it is delivered into the mains of the Companies.

One of the hardest problems which have during recent years been submitted to a Parliamentary Committee for solution, was that which was put before Sir John Brunner and his colleagues some weeks ago—viz., the adjustment of the rival claims of Derby, Leicester, and Sheffield, to the Derwent watershed—and the solution of which was recently given in the "JOURNAL." The Committee commenced their labours on the 26th of April, and concluded them on the 16th inst. Of course, the sittings did not extend over the whole of this period, as the Whitsuntide recess intervened, and there were several adjournments to allow of consultations between the parties; but the Committee had the matter in their minds, more or less, from one date to the other. The outcome of the protracted proceedings, our abstract report of which was concluded last week, was the consolidation of the competing measure into an entirely new Bill—the Derwent Valley Water (Consolidated) Bill—based upon an agreement come to by the parties, the text of which was given a fortnight ago. The Bill was passed by the Commons last Friday, and is now in the Upper House; and although certain objections have been reserved, there is little doubt that it will go through without much opposition. Looking at the claims of the three Corporations, it seemed that Derby, being the county town, should have the prior right to the waters of the Derwent; and Leicester, being in the watershed of the Trent, into which the Derwent flows, appeared to be justified in making her claim. But why should Sheffield, a Yorkshire town, seek to appropriate the water of another county? The only answer was that large towns are compelled to go outside their own contiguous areas for water, and that the example had already been set by Birmingham, Liverpool, and Manchester. A Joint Board is to be constituted to control the coveted watershed; and the works will be constructed under their supervision.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-SIXTH ANNUAL GENERAL MEETING,

HELD AT

THE WESTMINSTER TOWN HALL, JUNE 13, 14, AND 15, 1899.

Mr. SAMUEL STEWART, of Greenock, President.

PAPERS AND DISCUSSIONS.

THE EVOLUTION OF THE HYDRAULIC MAIN.

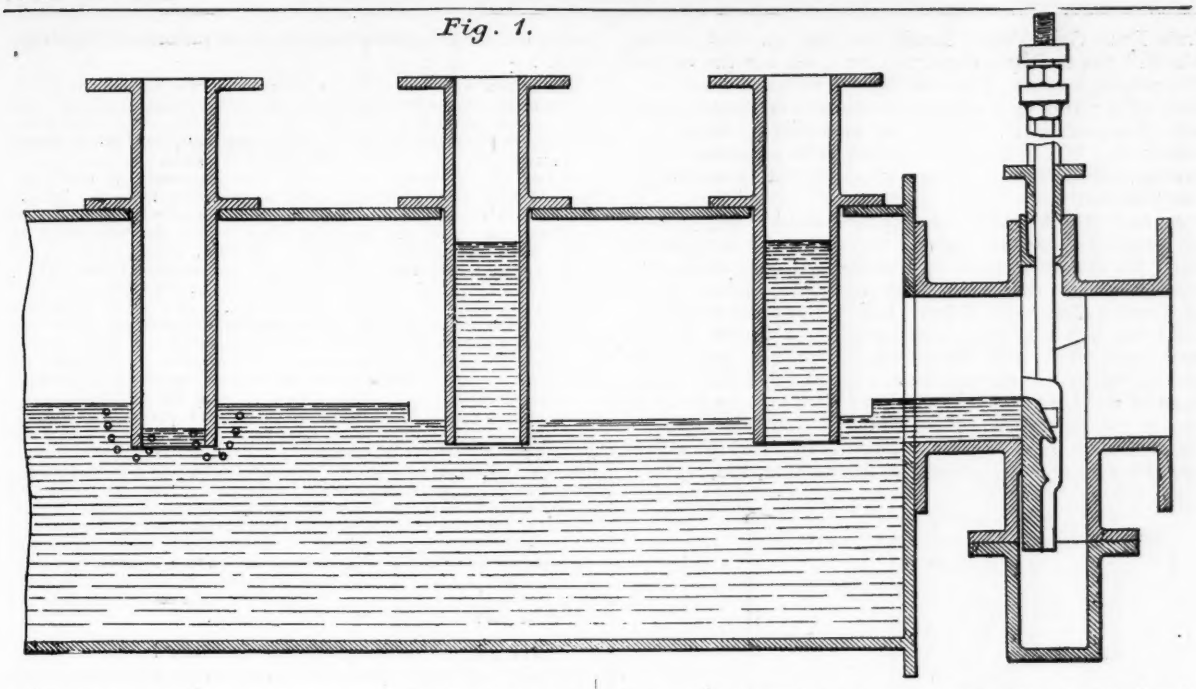
By WILLIAM CARR, of Stalybridge.

The part played by the hydraulic main in the economics of gas manufacture has been so quiet and unostentatious that its importance in a great measure has been overlooked. In the beginning, the hydraulic was nothing more nor less than a machine or physical contrivance for trapping the gas when once it had passed that particular point and preventing its return; and I am afraid that it is nothing more to-day to a vast majority of those who are engaged in the business of gas making.

I do not know who was the inventor of the hydraulic main, or whether there was such a man or not. It was probably the outcome of laboratory traps that had been in use before gas was thought of. Be this as it may, it remains the one unique and perfect machine in connection with gas apparatus. Physically speaking, it is without flaw or defect of any kind. This machine or instrument was designed before the days of exhausters, when the whole of the back-pressure was upon the retorts, and when it was thought prudent to use iron-retorts to prevent any waste consequent upon the large amount of pressure under which the retorts had to be worked. It will readily be seen that the part to be played by the hydraulic main in those days was one of great importance. It had to give free-way to the gases when generated; and it had to form a perfect barrier to the return of those gases during the time of drawing and charging, even though the pressure on the main itself might be anywhere from 10 to 20 inches. How beautifully this instrument discharged all these duties, will be apparent to all of you. How the area of the main was so nicely calculated, in comparison with that of the dip-pipes, that a depression of one inch in the main itself would supply sufficient water to fill up the dip-pipes to a height of 15 or 16 inches (as shown in fig. 1) is a matter with which you must all be familiar. You will observe the old-fashioned weir-valve at the end where all the water and the surplus tar were taken off along with the gas; some gas engineers taking them on a tortuous passage round the retort-house under the mistaken notion that the gases would thus be enriched, or that the formation of naphthalene would be minimized in some way. I have no doubt that in many works the arrangement still obtains; although the ideas which brought about that arrangement may have been superseded by later knowledge.

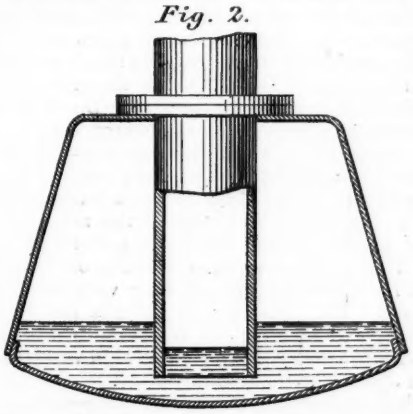
Had it been that only water found its way into this main, it would still have remained the most perfect instrument that could be designed for the work it was intended to do; and to-day I consider it the very best thing that can be used in a products works. At places where small coal is consumed for the sake of the coke, tar, and ammonia that can be extracted, and where gas is of no value or only of value as a heating agent, it will be found to be a very efficient instrument; for, in addition to its advantages as a hydraulic trap, it is a tar-making machine of the first water. As time advanced, however, people engaged in the manufacture of gas began to aim at getting better results. The exhauster was introduced, which made clay and brick retorts and ovens feasible, and higher temperatures of distillation came in vogue; and then it was that the hydraulic main began to assert itself, at first by getting blocked up with salts and very thick tar—the whole mass in some instances becoming quite solid—and later by its apparent effect on the choking of the ascension-pipes. In 1872, Mr. George Livesey read a paper before this Institute—or, as it was then called, the Gas Managers' Association—on the subject of hydraulic mains; and this, so far as I know, is

Fig. 1.



the only time that the matter has ever been under the consideration of the members of this Institute down to the present. Mr. Livesey had been having trouble with his hydraulics getting blocked with pitch and salts; and he was led, by reasons which need not be gone into, to design

Fig. 2.



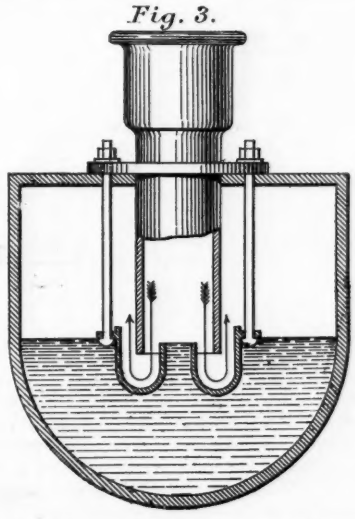
a form of main shown in section in fig. 2. In the course of the paper he makes use of the following observations:—

Various means have been tried to prevent or clear out this accumulation of thick tar, one being an enlargement of the hydraulic itself till, in one case that I have seen, each length would make a small Cornish boiler; then the elevation of the hydraulic from two to four or five feet above the brickwork with the object of removing it beyond the reach of heat—it being considered that the heat from the setting converted the tar into pitch. A stream of gas liquor has in some cases been caused to flow through the main; and for a long time I had a quantity of hot water from the steam-boiler put into the main once or twice a week. But this did very little permanent good. The making the main deeper and square at the bottom has been suggested; means for drawing off the tar from the bottom instead of the top have been devised and used with varying success; but by no plan, so far as I am aware, has the prevention of this accumulation been certainly and completely obtained. The causes of its production are twofold: First, the retention of the tar in the main; and, second, the heat of the gas from the retort, in passing through this comparatively stationary tar, evaporating its volatile constituents. *For it is the hot gas, and not the radiated heat from the setting, that does the mischief.* [The italics are Mr. Livesey's.]

Judging from the tone of the paper, Mr. Livesey seems to have been very proud of this invention; and the main itself seems to have been very successful in its operation. But at this time the average make of gas at the South Metropolitan works would not exceed 9500 cubic feet per ton of coal carbonized. It was even held by some eminent engineers that it was impossible to obtain more than that from a ton of coal without a greater or a corresponding loss of illuminating power; so that, under these favourable conditions (I mean favourable to the hydraulic main), it is easy to understand that Mr. Livesey's improved main was a complete success. Progress, however, could not be stayed at this juncture; and it began to dawn upon some of the more thoughtful that the hydraulic played a much more important part in the results obtained from the distillation of coal than had previously been suspected. At first, the slight amount of back-pressure thrown on the retort in consequence of the seal was supposed to be a deterrent. Then, again, the pulsation caused by the bubbling of the gas through the liquid in the main was supposed to have a baneful influence, especially in regard to the deposit of carbon on the sides of the retort; and so the idea got abroad that if the dip could be done away with much good would result.

A number of engineers of a mechanical turn of mind commenced devising means to remove the dip, and there followed a long series of patent anti-dips. One of the earliest of these (shown in fig. 3) was Hawkins's patent. I

Fig. 3.

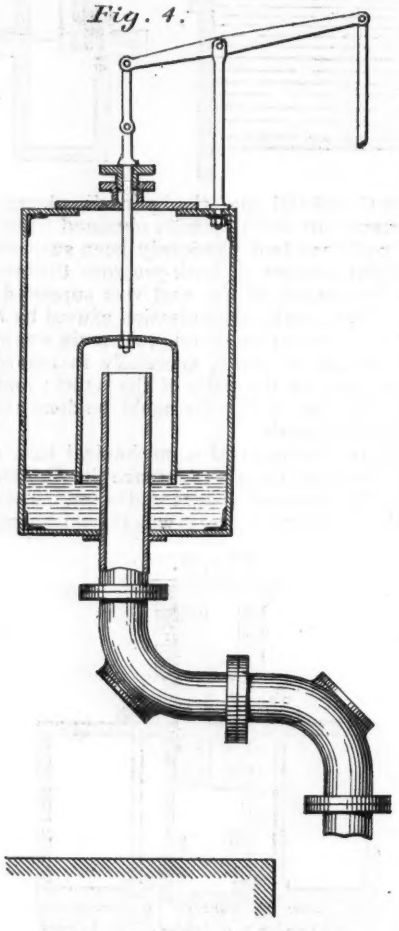


was greatly impressed with it when it first came out, and studied it carefully for a long time. I was sure there was something in it, because it was the subject of a patent; and I was equally sure that it was something very clever, because I could not understand it. However, by dint of long cogitation, I came to the conclusion that it was undertaking to do something that was not in harmony with the law of physics; and so I did not pursue it any further. But, at the time, it made a great impression on my mind; and as a pointer of the direction in which we ought to travel, it did me a great service. Along with others I tried several of these anti-dips experimentally; and it soon became apparent that wherever you could get them to work satisfactorily the results were improved. I did not satisfy myself, however, as to which particular form to adopt until I saw an arrangement that was working at the

York Road Gas-Works, Leeds (see fig. 4). Mr. Henry Woodall, the then Engineer, told me it was not the subject of a patent, and that I was at liberty to make what use I liked of it; and so I adopted it—first to 80 mouthpieces, and subsequently to a further 80, with varying results. I believe that Mr. Woodall was afterwards admonished for having adopted it, and ordered to take it out by an all-wise Gas Committee.

As with all other forms of anti-dips, trouble began with the removal of the seal in the way of pitchy deposits all about the apparatus itself and in the hydraulic main, and very often causing the ascension-pipe to get choked up to an abnormal degree. I have had the annular space betwixt the bell and the ascension-pipe so firmly blocked with hard pitch that the cast-iron bell has had to be broken before it could be got off. It was probably something of this kind that caused it to become unpopular at Leeds. With my first application of this anti-dip, I placed the main close down upon the retort stack; and the ascension-pipes entering the main at the bottom, the gas was

Fig. 4.



out of the ascension-pipe and out of the main itself before sufficient time had been allowed for cooling. The trouble I had with this arrangement was of the most grievous kind; but with the application of the second lot I placed the main 4 feet higher—almost doubling the length of the ascension-pipes, in the case of the top retorts. This proved so satisfactory in its working that I was not long before I exalted the first lot to a similar position; and, with careful handling and a little more care in the regulation of the heat of the retorts, we gradually got it into a workable instrument, and from that time it did me very good service. Finding I could get much better results, more especially with regard to the illuminating power of the gas produced, the question naturally arose as to the why and the wherefore; and I was eventually led to the conclusion that it was the presence of tar in the old hydraulic that caused the results to be poorer where it was used than was the case with removable dips. Had I been familiar with the most advanced thought and practice at that time, I should have known this, and much cogitation might have been saved.

The Rev. W. R. Bowditch, in his book upon coal gas, published 1867, has the following observations on the action of tar:—

> The hydraulic main ought to be kept at a proper temperature and to be prolonged sufficiently to allow the less volatile bodies to condense and pass away to the tar well, and the more volatile to go forward with the gas; or, what is much better, a special apparatus, kept at a regulated temperature, should be interposed between the hydraulic main (in this case kept hot, of course) and the purifying apparatus, in which the gas and lighter hydrocarbons might be separated from the heavier bodies, and so a larger proportion of hydrocarbon vapour might be distributed with the gas. In other words, the gas might be made more illuminating. If thus separated, there would be no difficulty in distributing all the light hydrocarbon vapour which the tar would give up, as may be proved by the well-known process of pouring naphtha into the mains, which the gas picks up on its passage and carries to the consumers. Gas at common temperatures can take up and carry a considerable quantity of the vapour of the lighter hydrocarbons, if they be brought into contact with it after having been separated from the heavy ones. But the power of the heavy to carry down the light is greater than that of gas to carry them on; and hence all fall together in the present system of condensation, to the great detriment of the gas. The loss of light which gas suffers upon being passed through cold heavy oil, and the inability of the same oil when heated to act upon it, will illustrate this. I have passed gas through heated heavy coal oil boiling about 400° Fahr., and have found its illuminating power identical with its illuminating power before it was passed through the oils. It gave up nothing to them, and it took up nothing from them. I have also passed gas through the same kind of oil at ordinary temperatures, and have had its illuminating power reduced to less than 1 candle for a consumption of 5 feet an hour, whereas before passing the gas through the oil it had an illuminating power of 13 candles. The cold oil has dissolved out of the gas nearly all its illuminating matter.

I have given this long extract, because I think it is an exact description of what takes place in the hydraulic. At any rate, I had arrived at a similar conclusion myself without having seen or heard of Mr. Bowditch's book, which you will observe is exactly opposite to the one enunciated by Mr. Livesey. If Mr. Livesey's remarks applied only to the negative gases that come off at the end of a charge or to furnace gases that may be drawn through leaky retorts by the action of the exhauster, I should agree with him entirely; but it is not so with the rich gases that come off in the earlier stages of distillation. In this case, the heavy tar or pitch liquefies at 400° Fahr., or thereabouts; and if it can, will separate itself from the gas. But if afterwards the gas be brought into intimate contact with it, it will absorb the light oils from the gas; its power to do so, as Mr. Bowditch says, being greater than that of the gas to carry them forward. And this no doubt is the secret of all the nasty stoppages which followed the adoption of the anti-dips of various kinds. Once you got the gas passing the hydraulic at a temperature of anything over 200° Fahr., you would have nothing but pitch or very thick tar deposited there. The light oils in the gas not coming in actual contact with it, it has no chance of absorbing them; and so after a few days' baking at a high temperature, it would, and did, become absolutely solid.

My brother, in carrying out his tar process, has experienced exactly the same trouble at Widnes, because he conducted the gases after leaving the duct directly into the foul main without any intercepting seal. The pipe leading from the duct he is obliged to have water-jacketed, in order that the temperature of the gases may be reduced so low before going one step further that sufficient of the light oils will be condensed to mix with the pitch, to enable it to flow. Otherwise he is liable to have his foul main completely blocked; and this unavoidably happens whenever the circulation of the water in the jacketed pipe is interrupted or neglected. And so it will invariably happen in any portion of the apparatus, whether it be ascension-pipe, hydraulic main, or foul main, if the gas passes through it at a temperature of over 300° Fahr.

The deduction from all this is obvious. You must bring your gas into the hydraulic main at a temperature not greatly exceeding 200° Fahr. if you wish to use a water seal or anti-dip. Before I had learned this much, however, I made many futile attempts to convert some old mains in which we had been working with a tar seal into water seal. I tried flushing with liquor, diaphragms to block the liquor and only pass the tar beneath, and mechanical arrangements for trapping the tar, of which I felt very proud and hopeful at the time. The success obtained, however, was very indifferent. Whenever I got the heats to anything like what I wanted, the result was invariably pitch, pitch, pitch. I have seen many similar appliances to those I tried make their appearance since as novelties; and I have smiled to think that someone was travelling over the same old road. We had got fairly well away with the new hydraulics, and went along swimmingly until 1881, when we introduced

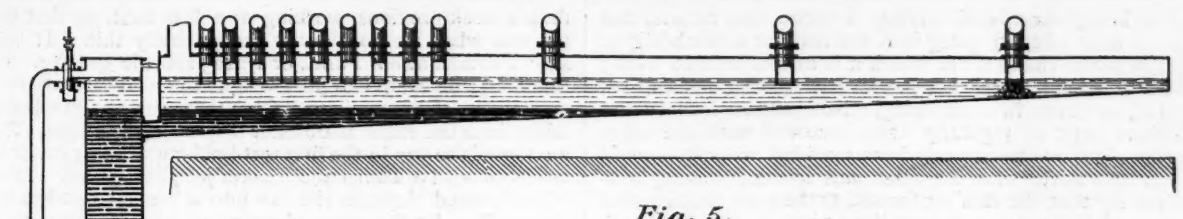


Fig. 5.

Fig. 6.

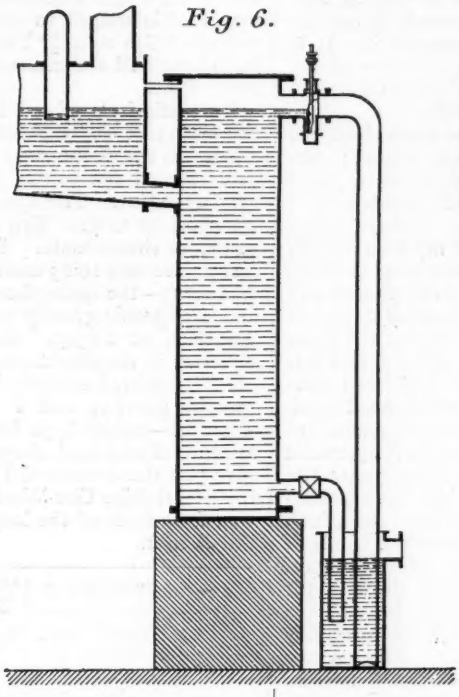
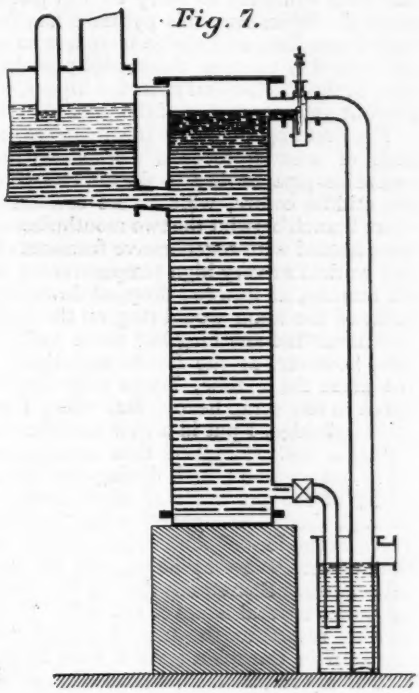


Fig. 7.



the regenerative system of firing, by putting in two sets of 32 mouthpieces to the design of Mr. Klönne, and three sets of 48 mouthpieces to the design of the late Sir W. Siemens; and these sets were put up where the Leeds arrangement of hydraulic main was in use. Up to this time, I had held the opinion that retorts could not be made too hot for the proper distillation of coal for gas-making purposes; but a new light was destined to break in upon me. I gave these furnaces their head. "Get them hot, and let us see what they can do," was my instruction to the workmen. In three weeks I completely ruined one set, and I greatly impaired the usefulness of the other four; but the trouble we had with the ascension-pipes and the hydraulic main was a revelation. I was reminded of it the other day, when a neighbour of mine told me they had at their works twelve men per shift working in the retort-house—four of them were stokers and the rest pipe cleaners. This was on regenerative settings also. I managed after a time to get the settings to work with a fair amount of success; but the stoppages occurred so frequently, even with the greatest care, that I determined to try a new departure in the way of a hydraulic main.

The conclusion now arrived at was that it was wise to keep in the gas the whole of the light oils that the gas was capable of carrying; also that it was necessary to take out sufficient to liquefy the heavier tar or pitch that first fell down, in order to give it power to flow by gravitation to the wells, and to be of such consistency that it might afterwards be pumped from the wells. Here was a plain issue to be solved. Whether the efforts made have resulted in a solution or not is difficult to say; but they have at least gone some distance in that direction. When a fresh charge of coal is put into a retort, the gases that come off in the early stages of distillation must come off at a comparatively low temperature; and the light oils as well as the heavy oils will fall together for a time. As the temperature rises, only the heavy will fall; and towards the end of the time of distillation the gases carry scarcely any vapour capable of liquefying at normal temperatures, but are capable of taking up from the pitchy matter deposited on the sides of the ascension-pipes, or elsewhere, any oily matter it may contain and converting it into a solid, or, at least, a very hard, substance. Until the temperature of the gases be reduced to something below 200° Fahr., they are capable of doing this at any point. A perfect instrument would be a telescopic ascension-pipe that could be closed at the beginning of the distillation process and gradually elongated as it proceeded; so that the effluent gases should never enter the hydraulic at a temperature exceeding 200° Fahr. But as that is so far practically impossible, the object to be aimed at was to utilize the light oils that must fall to help off the heavy that you were compelled to dispose of, and later to reserve all the light oils that you could for the purpose of enriching the gas. The question of keeping the light oils in the gas after getting them safely past the hydraulic, I will not attempt to deal with to-day. It is matter enough for another paper.

After what I have said about the difficulties encountered, and my progress educationally towards a more complete knowledge of the functions of a hydraulic main, it will scarcely be necessary to give you my reasons for going in for the special kind of main eventually adopted. The main itself is illustrated in fig. 5. It will be seen at once that it is very orthodox, inasmuch as the pipes go into the main at the top in the old way, and there is great depth, especially at the outlet end. The sloping bottom of the main is intended to keep the tar on the move, while still in a liquid state, towards the outlet. When it gets there it either mixes with the other tar already accumulated, or passes forward into the stand-pipe or tower (shown in the illustration) for receiving the same; and as some of the tar already accumulated will probably be of a fairly liquid character, it assimilates with it and helps to move the heavier tar along. It will be seen also that any light tar falling in the early stages of distillation must inevitably encounter the thick tar of some other stage; and so far it is a perfect self-acting machine carrying into effect the theory I had elaborated.

The illustrations, figs. 5, 6, 7, show it in different stages of work; the first (fig. 6) entirely filled with water; the second (fig. 5) partially filled with tar; the third (fig. 7) with tar overflowing. One of the drawbacks attending the latter stage is that the different specific gravities of the two columns will cause the level of the water to be raised, but that is not a serious defect. We have had some little trouble with the large pipe at the shallow end of the main. The

pipe being short, and having to serve two retorts, the gases must often be going into the main at a much higher temperature than that at which it is safe or wise to work; and the result has been the formation of a pyramid of pitch, as shown in the drawing. Now, although these conditions must as regularly have occurred with the other three pipes, we have rarely been troubled with the second one, and never with the third and fourth; proving conclusively that the thin tar formed at the same time in other parts of the main, and travelling towards the deep end, has been sufficient to carry off the pitch formed in that portion. Whenever this pyramid has formed, it has required crowbars and sledge hammers to remove it. It is my intention to raise the bridge-pipe in the case of the pipe at the shallow end 18 inches higher, which I think will prevent any recurrence of the pyramid trick.

The first application of this main was to a bench of five beds of retorts, settings of nines (three threes); one ascension-pipe having to do for two retorts, the top and the middle centre, which were connected together by a short branch betwixt the two mouthpieces. These settings were heated with regenerative furnaces of my own design, and worked at very high temperatures; but after working six months, an iron rod dropped down the dip-pipe at any point of the main would ring on the bottom as though it had never had anything but water in it. It met the same fate, however, as the Leeds anti-dips. After I had left the place for a time, I was told that it had been relegated to the scrap heap. But when I commenced work at Stalybridge, I put in a new installation of regenerative settings, and I applied this arrangement of hydraulic main throughout; and during the last three years the whole of the gas made at those works has been passed through them. Our practice has been to open the 4-inch valve at the foot of the tower, and run away the whole of the tar once every 24 hours, and fill the main up again with water. Sometimes the tar has been so thick that it has taken several hours to run off. At other times I have had to resort to the use of cannel to help to liquefy the stuff in the main. As I have furnaces only on one side of my retort-stack, I have always used the cannel on that side; so that the coke from it could be consumed in the furnaces, and not interfere with the quality of the coke I had for sale. The tar from the mains on this side was invariably much thinner than that produced on the opposite side, where only coal was used.

I have already mentioned one of the defects of this main—viz., the extra back-pressure when tar is overflowing. It has several others; the principal being the careful handling required in running off and refilling. Another is the danger of getting the tar so stiff that it will not flow at all; but this is common to all forms where the manager tries to sail too close to the wind in the matter of high heats and large yields. In filling up after running the tar off, it is necessary to fill right up so that the pipes are sealed. We have left it rather short on several occasions in the belief that it would fill itself up before the time of the next draw; but it never does this. When the hot gases are playing on the surface of the water without bubbling through it, the evaporation which takes place is greater than the liquid deposits from the gas; and they might be fraught with serious consequences if overlooked. But, given the requisite care and attention, it is a very efficient instrument indeed. There need be no question of enrichment where only 16-candle gas is required if a main of this kind was in use—that is to say, if Newcastle or South Yorkshire or Lancashire coal be used. I have seen many samples of coal in the Transvaal that would not make 16-candle gas under any circumstances; and there may be some in this country. But speaking of the coals of this country of which I have had experience during the last 30 years, there should be no difficulty.

Bearing on this point, I had a sample of tar taken from one of these syphon-pots on the 17th of May last, and found, after passing 10 feet of gas through it from one test holder to another, that 3½ candles had been taken out of the gas. This experiment was so interesting that I determined upon a series of more carefully conducted tests; but the results worked out with such sameness and regularity that it will not be necessary for the purposes of this paper to give more than one. On the 23rd of May last, a sample of tar was taken from the syphon-pot of one of the mains in operation; and, owing to some defect in the flues, the sets at work on this main were, and had been for more than a week previous, working at a low heat, so that the tar was what we considered exceptionally thin. It was 42½° Twaddel at 60° Fahr., or 1·2125 specific gravity. Of this tar 32 oz. were carefully weighed in a Wolffe's bottle, and 10 feet of gas made to bubble through; the gas being taken from the street main after it left the gasholder. The quality of the gas in the first test-holder was 19·75 candles, as tested with a Thorp and Tasker jet photometer. After it had passed through the tar into a second test-holder, the quality, by the same photometer, was 16·75 candles; and when weighed afterwards the tar was found to have increased in weight to 32·331 oz., and the specific gravity to have fallen to 41½° Twaddel, or 1·2075 at 60° Fahr. I had about half-a-dozen tests made; but the variation was very slight.

For curiosity's sake, I had a sample of tar taken from the outlet of the condenser (horizontal, flat screw) and treated in the same way. To my surprise, I found that this affected the gas in the same way, only to a much smaller extent. The specific gravity of this tar was 18·2° Twaddel, or 1·091. Ten feet of gas was passed through 32 oz., or thereabouts. The quality of the gas in the first test-holder was 19·25 candles, and in the second holder it was 18·75—the same photometer being used in both cases; and the specific gravity of the tar afterwards being 18·1° Twaddel, or 1·0905. During the winter, having some difficulty in moving the tar from place to place on account of its stiffness, I thought I would like to have it tested for specific gravity, and I found it to be 1·232, or 46·4° Twaddel—rather high for commercial tar made from a mixture of coal and about 18 per cent. cannel. Below I give you the commercial analysis of the tar produced at the Stalybridge Gas-Works over a lengthened period, and that from some of the larger and more important works in the district.

—	Water.	Naphtha.	Light Oils.	Creosote.	Anthracene.	Pitch.			Loss.	
	Galls.	Galls.	Galls.	Galls.	lbs.	c.	qrs.	lbs.	qrs.	lbs.
Stalybridge	12	5	2	42	13	13	3		1	21
A	9	5	8	50	14	12			1	26
B	9	5	6	49	13	12	3		1	10
C	11	7	7	45	14	13			1	12
D	6	5	13	54	10	12	2		1	14
E	7	7	14	50	12	12			1	21
F		7½	13	50	10	12				
G		4½	18½	52½	10	12	2			
H		5½	8	47	13	13	1			
I		5	6	40	12	13	2			
J		10	20	47	13	11	2			
K		3	3½	40	12	14	3			

I cannot (for obvious reasons) give the names of the places from whence these various tars have been obtained with the exception of my own; and here I am fully conscious that the information I am giving may be used to my detriment. But of such importance do I consider the information, that I have determined to risk it. More especially is it important in the light of modern development of gas manufacture, when the most eminent of our gas engineers, or, at least, those who occupy the most eminent positions, go to America for systems of enriching—systems that are admittedly expensive, and that involve the use of oil from America or from Russia—while the best of all material is at hand, and requires only the application of brains to utilize it.

Discussion.

Mr. R. G. SHADBOLT (Grantham) suggested that the more correct title for the paper would have been "The Evolution of Mr. Carr," rather than that of the hydraulic main; but it was really very interesting to anyone who had followed Mr. Carr through the various stages of the development which had brought about the construction and use of this hydraulic main. The chief point enunciated seemed to be the necessity of keeping the constituents of the tar within workable bounds—in other words, so dealing with the tar at the first stage of condensation that it could be dealt with afterwards or removed readily without trouble. With the high heats now in vogue, this was a great difficulty. The author said it was absolutely necessary to retain a certain proportion of light oils in the tar, so that it might be easily handled; and then he proceeded to show how to achieve this object by means of a sloping hydraulic main. The question to his (Mr. Shadbolt's) mind was whether this was the best way of effecting his end. Many of them had hydraulic mains

which had been in use for some considerable length of time; and it was not an easy matter to re-model a hydraulic main unless extensions of the carbonizing plant were being undertaken. He, however, thought there were other means which would be equally efficacious for getting the tar into a workable condition. Mr. Carr led them to believe that it was, to a great extent, a question of temperature. He (Mr. Shadbolt) had been interested, when taking observations of temperatures on various occasions of the gas issuing from hydraulic mains, to find what a tremendous variation there was between the gases from one hydraulic main and another—working under identical conditions, where a separate main was used for each individual bed. Not only so, but there were great variations in the temperatures of the gases issuing from given retorts or ascension-pipes and from a given hydraulic main at the same period of the charge but at different times of the day. The great difficulty appeared to be to obtain anything approximating to the temperature which Mr. Carr laid down as that at which the gas should enter the hydraulic main. When Mr. Carr got into a difficulty with his pitch, he told them to reduce the pitchy tar by the use of cannel. This was all very well; but where cannel was expensive, any such method would be costly. He wished Mr. Carr had continued his experiments back until he got to the mouth-piece, because his (the speaker's) experience was that, although there were ways of keeping the hydraulic main clear, still a solid deposit formed in the ascension-pipe, and it was not possible to keep the gas from leaving the mouthpiece of the retort at a certain temperature. The question was to reduce the temperature between the mouthpiece and the hydraulic main. This raised a great difficulty, because however clear the hydraulic main might be kept, there would still be trouble with pitchy deposits in the ascension-pipes; and he should have thought the paper much more complete if the author had given the result of his observations and experiments as to preventing deposits in the ascension-pipes as well as in the main. He thought one might be quite safe in advocating a separate hydraulic main for each bed, as distinguished from the one suggested by Mr. Carr, taking the gas from four beds of retorts. Assuming a gas manager were going to erect a bench of eight beds, he supposed Mr. Carr would simply double the arrangement and erect one of his tar-towers at each end of the bench. But very often, in a retort-house, space had to be economized; and this would take up a certain amount of room at each end, which might be utilized to better advantage. Still another drawback he (Mr. Shadbolt) should imagine would be that in flushing the hydraulic main all the dip-pipes would be unsealed at once, and the dangers of unsealing (such as they might be) would be increased. But they would be minimized if it was connected to one bed at a time, instead of running the whole four dry. Many of the troubles in hydraulic mains and ascension-pipes were due to unequal charging. If the charging were done by the ordinary method, and a change made from retorts 8 feet long to 10 feet long, it would be found physically impossible to get the men to put the coal equally over the whole length of the retort, and at the back end there would be a much higher temperature than there ought to be if the charge was equally distributed. He thought therefore one must look to an equal distribution of the charge for minimizing all these troubles, as much as to anything else. If a charging-machine were used, it would be found that the charge was thin at the back-end; but if shovel charging were adopted, the skill of the stoker had to be relied on, and with sloping retorts there were also difficulties such as creeping, &c. He believed the prime factor in all cases was unequal charges. This also accounted for the great variation in temperature he had noticed on several occasions. The principle involved in the paper was what had been called enrichment of gas. It was a question throughout of the manipulation of the light oils; and he thoroughly agreed that there was no need to look round for other sources of enrichment until they had exhausted the means now at their disposal. He had no doubt that in gas as ordinarily manufactured there were sufficient light oils, not only to keep the tar of manageable consistency, but also to effect sufficient enrichment in ordinary cases.

Mr. G. R. Hislop (Paisley) agreed very much with Mr. Shadbolt in thinking that the method of filling the retorts had a great deal to do with the deposit of tar. They were often filled too slackly at the back; and the result was that a decomposition of gas took place there, and the particles of carbon or soot floated up through the ascension-pipes into the hydraulic main, which tended to thicken the tar there, and produce mischief. The same remark might be made with regard to the through-retort system. It was an utter impossibility to draw the gas from both ends of the retort simultaneously. It was also impossible to set the exhauster dead in the centre, and make it draw the gas equally from both ends. If the gas had to pass through 20 feet of retort, when it got to the one end, he had no hesitation in saying that there was a loss of from ½ to 2 candles in illuminating power; and he thought it much better to use short retorts of from 9 to 10 feet long, and thus make every retort responsible for its own work. With regard to the accumulation of tar, the principle adopted by some, of having one hydraulic main for every setting, was, in his opinion, a mistake. The mains of not less than two or three settings should be joined together to reduce the thickening effect on the tar. If this was so arranged, a more regular flow of tar was secured, and a freer main. Where working with one bench on a main at a high heat, there was a very slow flow of the thick tar, consequent on the small production of gas; and therefore he advocated two or three settings being kept together, and having one outflow only taken from them. He believed the secret of most of the difficulties complained of was in the charging of the retorts. They should be properly filled at the back, and slightly tapered towards the front; but the practice was often just the reverse of this. The same result occurred if the retorts were too deep in relation to the charge. He thought 15 inches was quite deep enough for English coal, and 14 inches for Scotch, because if there was too much heated surface the same mischief occurred as with slack filling at the back end, or with through retorts.

Mr. J. P. Leather (Burnley) said he could not help agreeing, to a great extent, with the principles laid down by Mr. Carr; but, in practice, it was not necessary to have just the form of hydraulic main he suggested. One might have difficulties or be free from them under very similar circumstances as regarded the hydraulic main. They had all had such difficulties as were referred to by Mr. Carr when he mentioned a works having eight pipe jumpers to four stokers. He (Mr. Leather) did not say he had ever been quite so bad as that; but he had certainly had great difficulties some years ago with a hydraulic main. When he first adopted West's charging machinery he had the hydraulic dip-pipes entirely filled up with pitch. He had White's valves on; but the valves were obliged to be taken out of them. He had the dip-pipes and the bodies of the White's valves all made up with pitch, and the ascension-pipes the same for 9 feet in length. The same settings with the same hydraulic main were, strange to say, working now with higher heats; and he was getting better results without that same difficulty, though he would not say without any stopped ascension-pipes. Then came in the question of regular charging. When the retorts began to get scurfed up, so that they could not get the West charger properly into the retorts, they soon got stopped pipes. He rose, however, on the present occasion principally to raise a question with regard to one or two figures in the paper. Mr. Carr said a perfect instrument would be a telescopic ascension-pipe which should be closed at the beginning of the charge and gradually elongated so that the temperature of the gas should not exceed 200°. The implication appeared to be that the temperature of the gas entering the hydraulic main rose as the charge got spent. He had not conducted many experiments on this point; but some years ago he did contrive to have a thermometer at the top of the ascension-pipe, and he found that the reverse rather was the case. To begin with, the temperature was lower; but when the charge had been in about 15 to 20 minutes with fairly high heats, it got to the highest point, and then gradually reduced towards the end—the reason probably being that most of the gas was then coming off, and the ascension-pipes were not able to cool the gas sufficiently; but as the rate of make of gas decreased, the ascension-pipes cooled the gas better.

Mr. C. S. Ellery (Bath) said they were much indebted to the author for his very interesting paper, which recorded the result of a number of experiments in a very full manner, and would be helpful to many people who met with these troubles. Nevertheless, he had one or two criticisms to offer. First of all, as to the closing paragraph of the

paper, it seemed to him quite unlike Mr. Carr; and he fancied he had got into a vein of rhetoric, and wanted to finish up with a flourish instead of an argument. He told them it was generally admitted that certain methods of enriching which he did not propose, were expensive. But he did not attempt any argument to prove that this was the case; and if he would excuse him saying so, it was not everyone who admitted that these methods were more expensive. It was probably intended as a fair knock-down blow for carburetted water-gas plant, which some who used it would not admit. As to the form of this hydraulic main, the more he looked at it, the more he was disposed to wonder why it should be made in this particular form. All the author was aiming at might surely have been gained by putting a well immediately under the hydraulic main to receive the tar—from the bottom of the main, not the end. In this way it dropped away from the water as the manufacture proceeded. This, at all events, was his experience. He would suggest that, in putting in such a well, it was of the utmost importance that the opening from the hydraulic main should be sufficiently large. They had tried this plan with openings from 2 inches up to 6 inches, and the difference in efficiency was greatly in favour of the larger size, so that there should be no tendency for the opening to choke with thick tar. A well such as that placed under the main, would answer every purpose, and be much less costly than such a one as had been shown with the tank at the end. Then Mr. Carr suggested, and he (Mr. Ellery) quite agreed with him, that there would be some difficulty in the water-line varying at the top of the tar, because of the difference in specific gravity; but he fancied he saw a small pipe from the hydraulic main into the second vessel, which he imagined was to take off any pressure formed in the ascension-pipes by the level of the water rising unduly. He would suggest that this difficulty was easily got over by making the liquor-overflow pipe 2 inches in diameter, and putting in a weir-valve. By regulating the valve, it was possible to get an exact balance between the tar and the liquor; and the fluctuation in the water-line was disposed of. This also had been proved in practice. He agreed with the suggestion that single settings could not work so well as where there were three or four in one section. The tar that came off from the gas in one setting of six, seven, or eight retorts certainly was at times in a very unfit condition to flow away without the assistance of thinner tar from other retorts. In his own case, he had tried single settings, and had been compelled to knock out the division, and let four settings work into one common main. As to drawing off the thick tar every 24 hours, it scarcely commended itself to him as a safe operation, unless someone was present in whom the manager could place great reliance, because it seemed rather dangerous to empty the hydraulic main when in work and possibly lower the water-level. If a well were placed under the hydraulic main, and the tar kept moving, such an arrangement was scarcely necessary. He did not suppose Mr. Carr would agree with the suggestion that he was now going to make; but, after some years' experience, he would suggest that where there was trouble of this sort, it might be got over by putting tar on the coal when it was introduced into the retort. He brought this method before the Institute some years ago; he was still adopting it, and saw no reason to dispense with it. He might also remark, for the benefit of those who had carburetted water-gas plant, that the tar which came from carburetted water gas was more useful than that from coal gas—indeed, as a solvent for deposits in pipes or hydraulic mains, it was invaluable. He should like to confirm what Mr. Hislop had said about the secret of the whole trouble being not so much in the plant itself as in the way in which it was worked. If the charges of coal were thrown well back into the retorts, and there was no hollow space at the back, there was very little trouble with thick tar either in the ascension-pipes or the hydraulic main. But when the men became careless, the backs of the retorts got very hot, and then a deposit of carbon followed. He could not agree with what Mr. Hislop said about solid-end retorts. He had them in one house where they were working stoking machinery, and the great difficulty was in getting the charging machine back. It was very apt to batter the end of the retort or cripple it; and this took place to such an extent that they had to take out the stop-end and revert to through retorts.

Mr. J. Lyne (Wexford) said there was one point in the evolution of the hydraulic main which Mr. Carr had not alluded to; nor had he mentioned the name of the man who first introduced that important change. In 1863, if he remembered rightly, Mr. Whimster, of Perth, thought of taking off the tar from the bottom of the hydraulic main in a simple way, by tapping the main at its lowest point, and screwing a pipe into it, and also taking a gas connection off the top of the main, to prevent its total discharge, when both pipes were connected with a T-piece at the right level for maintaining the desired seal for the dip-pipes. By this means Mr. Whimster was able to draw off the heavy tar from the bottom of the main, and have the dip-pipes sealed in liquor. Ever so many valves had been invented since that time to accomplish this; but Mr. Whimster's principle remained still the same, and what was shown in the drawings was only a variation of it. The plan of removing the heavy tar from the hydraulic main, instead of allowing it to rest there to be distilled, so as to leave only a pitchy deposit—as in fig. 1—was Mr. Whimster's idea. He (Mr. Lyne) agreed with some of the speakers that there was no necessity for the cumbersome form of main Mr. Carr had suggested. All that was necessary could be done by having a sufficiently large pipe—4-inch at least—attached to the bottom of the main with a suitable bridge-valve and gas connection from the top. One very important point in the paper was the allusion to the temperature at which the gas entered the main; and Mr. Carr's advice on this was well worth attention. It was hard to see how a telescopic ascension-pipe could be applied; but, since reading the paper it had occurred to him that it would be an advantage to have the ascension-pipes from the top retorts of greater length than usual, and so have them at least as long as those connected with the bottom retorts. His experience was that there was much greater tendency for deposits to take place in the bridge-pipes connected with the top retorts than in those attached to the lower ones, although the heats were apparently the same (or nearly so) for the top and bottom retorts.

Mr. Henry Woodall said, as his name had been mentioned in the paper, he might offer a remark or two upon the contrivance which was fathered on him. He had simply to say that he tried it first of all at Burslem in a long continuous main; but it was not a success, and was abandoned. At Leeds, he tried it on one length of through settings; and it did not answer there either, and was abandoned. The fault was not in the arrangement of the anti-dip. All that he did was to introduce a form of valve which was first invented by Mr. Spinney, the Engineer of the Cheltenham Gas-Works, some fifty years ago. This valve was in use there not more than ten years ago, and had been in use the whole of this time. The system, therefore, was successful in itself; only there was some defect in his method of using it.

Mr. Thomas Hands (Enniskillen) asked whether, when Mr. Carr emptied his hydraulic main, as he said he did every 24 hours, and filled it up again, this was with ordinary water or liquor; and if the former, whether he found that it decreased the illuminating power of the gas so that he had to use more cannel to bring it up to the right standard again.

Mr. W. Hardie (North Shields) agreed very much with Mr. Carr, that there could be no doubt the proper thing was to seal the hydraulic main in liquor, not tar, both for the sake of illuminating power and also on account of the enormous advantage it gave with regard to stopped ascension-pipes. These were caused largely owing to working at very high heats. How the hydraulic main sealed with liquor and kept at a rather cooler temperature prevented this was perhaps not as clear as it might be; but those who had worked a good hydraulic main sealed with liquor would have found the enormous advantage it conferred. In his own case, they had changed from a tar seal to a liquor seal by placing a 4-inch tar-main running longitudinally behind the hydraulic main, and taking bends from the bottom of the hydraulic main, and regulating with hydraulic main valves. They found that this worked fairly well; the only difficulty being that, in taking both tar and liquor over the valve in this way, there was often an accumulation of tar on the top of the slide, and the seal varied slightly. He also found in the tar and liquor running away they were apt at times to get the tar very stiff; so that it did not run. To prevent this, they now kept a constant small stream of ammoniacal liquor running into the hydraulic main, which went down with the tar,

and was found sufficient to keep the tar in a working condition and get it to the tar-well some 250 yards away. They found it better to take a special pipe from the bottom of the hydraulic main, and run the tar off periodically, rather than have it go over these special valves.

Mr. D. T. Livesey (East Grinstead) confirmed Mr. Carr's statement with reference to the temperature of the gas leaving the main. Some time ago, when he was at Aldershot, one of the Directors of the Company had the idea of reviving an exploded suggestion which appeared in the "Journal of Gas Lighting" some 20 or 25 years ago—it was by Dr. Eveleigh, he thought—for taking the gas off the back of the retorts with short descending pipes. Having three beds designed by Mr. Valon on the generator principle, they adopted this system, and took the gas off the back of the retorts—placing the hydraulic main on the floor-level behind. From the beginning, they experienced a great deal of trouble in working these beds; and after about two months they had to do away with the descension-pipes altogether. On taking off the top plate of the hydraulic main, when dismantling the setting, he found the hydraulic main was absolutely one mass of pitch within ½ inch of the top; and it astonished him how the gas had ever got away from the bed at all. This showed that the very high temperature at which the gas was brought into the hydraulic main tended to make the tar settle down there as one mass of pitch, and block the whole thing up. If he rightly followed Mr. Carr in reading the paper, the first part of it went to show that a certain amount of light oil must be retained in the tar to make it flow at all; but at the end of the paper he showed that his tar only contained 2 per cent. of light oil, while everybody else's contained much more. He thus did what other people did not—retained the light oil to influence the tar; and yet he managed to finish with hardly any light oil at all. It would be interesting if Mr. Carr could show how he obtained this result by arranging special apparatus to retain his light oils in his tar, and at the finish being without them.

Mr. Isaac Carr (Widnes) said a point which did not seem to have been so far appreciated by many speakers was that the hydraulic main was made in this form because tar on an incline would flow better than it would horizontally, and that the pitching-up as shown at the shallow end was what obtained in the ordinary horizontal hydraulic, but was avoided in the lower portion. Whether this was connected with one, two, three, or four beds, as advanced by various speakers, the tendency to stop up still remained; so that even the adoption of the well suggested by Mr. Ellery would not get over the difficulty. It was all right when the tar got to the well; but the difficulty was to get it there. If the main were on an incline, instead of horizontal, some of the danger would be removed. He had taken the trouble lately to make a few tests of the temperature of gas passing from the retort to the hydraulic; and, comparing the results with those of Mr. Leather, reminded him of the force of what Mr. Shadbolt had said about the variation in the temperatures. The point of observation was the top of the dip-pipe, and he found, in his experiments, that in no case was the maximum temperature of the gas passing from the retort into the hydraulic main reached before one hour, and in some cases two hours. It was quite true a very rapid rise took place in five or six minutes; but an hour elapsed before the maximum temperature was reached in the quickest instance. The 200° mentioned in the paper as being the point the gas should be kept under to prevent the deposit of pitch, was perhaps rather high; for he was inclined to think that pitch would deposit with gas entering the main at a very much lower temperature. His experiments were made on settings fired on the regenerator system with what he considered high heats. With the coolest retorts, which would be about 1600° to 1700°, the highest temperature obtained at the dip-pipe was 150°; and the hottest retorts, immediately over the combustion-chamber (say, 2000° Fahr.) attained for a few minutes only, just 200° at the point of observation. Only in one case did they get the extreme temperature of 200°. The temperatures were for the most part well within 200°; and yet sometimes they were troubled with pitch. With regard to the concluding paragraph of the paper, he would not attempt to take up the cudgels on behalf of his brother, who was quite able to defend himself; but many of those present were as yet by no means content with the existing method of coal gas production in the ordinary way—they were satisfied that the best had not yet been done—and those who were "fortunate enough to possess water-gas plant" had yet to show that, notwithstanding the numerous advantages they claimed, economy of production as compared with coal gas was one.

Mr. William Carr, in reply, said perhaps it would have been better if he had adopted the title Mr. Shadbolt suggested, as there certainly had been a process of evolution going on with him with regard to the function of the hydraulic main. He feared that, from a desire to be brief, he had not made his ideas quite clear to all the members. He need not go into the question of stopped ascension-pipes because this was not the subject of the paper; in fact, when he was invited to prepare the paper, he was under the impression that there was going to be another one on this very subject. With regard to the hydraulic main, he had tried to make it plain that it performed a certain function. When using a tar seal, it robbed the gas of a great quantity of the light oils. If a gas manager could afford to do without the light oils, the best hydraulic main of all was the old one; it was not needful to have any sloping bottom or to take the tar from the bottom or anything else. With those who were willing to work the hydraulic main at a low temperature, and let the tar do all the work it could, there was no need for any improvements at all in the shape of anti-dips or anything else. The old hydraulic main was the most perfect physical machine ever invented for the purpose for which it was applied. He (Mr. Carr) did not know anything whatever about Mr. Whimster's action in 1863; in fact, many things happened before he started to work. Mr. Shadbolt said it would be dangerous to unseal four beds and draw off the tar; but when they drew it off, they invariably commenced by letting the water run in before drawing the tar off, and generally the flow of the water into the main was at about the same rate as the flow of the tar out of the foot tower. The tar, being stiff, did not run rapidly; and the moment they found the tar stopped, and the water running, they shut it off and found out by testing the main that it was filled up again. It was as he had already admitted, a defect in the apparatus, and it required attention. With regard to the charges of retorts being uneven, that again was not the subject of the paper. When old settings were used which had sunk down, there was of, course, an unequal distribution of charges with almost any system. But what he claimed for this hydraulic main was that it, to a great extent, counteracted the difficulties which arose under these circumstances with the ordinary main, when the tar was supposed to be removed. Mr. Ellery failed to see the value of this particular shape of main, and thought a horizontal one would do as well, though he agreed with him in having four or five benches on one main. His brother had already dealt with this question to some extent. The advantage of having the sloping bottom was to keep the tar on the move while it was liquid. He quite agreed with Mr. Ellery in regard to putting tar on the coals; but that again was a subject of a different kind. They knew the tar distillates would throw off a lot of light oils, and leave a lot of carbon as residue; and, therefore, the more light oils that were passed through the ascension-pipes (provided they were properly condensed), the better they got away, and the more liquid would be the residuary material in the hydraulic main. He could quite believe that Mr. Ellery got very good results by doing this; but he considered tar too valuable to use in any such way. With regard to the question as to the kind of water used, and whether it reduced the illuminating power of his gas, he could only say that it was ordinary town water—not liquor—and it did not affect the illuminating power because gas passing through water was not reduced in illuminating power to any appreciable extent—that effect was only produced by passing through tar. Mr. Hardie's system he could quite believe acted as he said. It all depended on the amount of light oils that were to be taken out of the tar as to the efficiency or otherwise of the form of hydraulic main used. With reference to Mr. Woodall, he might remark that in the earlier part of the paper he (Mr. Carr) had stated practically what Mr. Woodall himself advanced. He would point out with regard to the table at the end of his paper, that the point of interest was in the third column, which showed that 2 gallons of light oil were left in the Stalybridge tar. With his main they could take these 2 gallons out; but the residue which would be left would not float at all; it would remain

there, and would have to be dug out with pick-axes. They were obliged to leave some light oil in the tar, in order that the resultant product should flow down the slope and get into the tower, and eventually away to the tar-well; and it should be sufficiently liquid when in the well, and cooled to normal temperatures, that it could be pumped out, and transmitted to the boats or railway tanks as the case might be. The column of the table he had referred to showed that the light oils varied from 2 gallons per ton to 20 gallons. If they were still willing to go on parting with 20 gallons of light oil in every ton of tar they sold, they need not adopt this method—the old hydraulic main was quite good enough, and they might go to bed comfortably and be satisfied that the works would go on safely while they were peacefully reposing. But some gas managers tried to improve on the results of their forefathers. He was one of them. He had tried to do a little bit more than anybody else; and in so doing he had encountered the difficulties he had mentioned. He had been gradually brought to design this hydraulic main so as to overcome these difficulties, and he had candidly told them how far it had succeeded. He had shown the difficulty which occurred at the shallow end, because there had not been a sufficient quantity of tar flowing past this point to carry the pitch forward and liquify it as it formed; and therefore it made a pyramid, and blocked up the dip-pipe. At the dip end there was a pipe on two similar retorts, but in another setting; but the tar coming down from above, which had been condensed from the cooler pipes, must have carried away the thick tar or pitch which would otherwise have been deposited here as the circumstances were similar. They, however, had never had a pyramid form at this point, as it frequently did at the shallow end; and, therefore, they used four beds on one hydraulic main, so as to utilize the tar formed in the early part of the charge when the gas would get into the main at a temperature of less than 176°, when the benzols and naphthas would be liquified to mix with, and help off, the thick tar formed at other points (lower down, of course) where the gas was entering at a temperature of 200° Fahr. or over. In the early stages of a charge with the ordinary machinery, one was bound to have gas going in at a less temperature than 176° for a time; it only got above that after the cold body of coal was beginning to get to the temperature of the retort itself, and the gas began to get out. The light oil was bound to be lost; but it could be utilized to wash away and dissolve some of the thick pitch which formed later on in the process of distillation.

RECENT EXPERIENCE IN THE WORKING OF INCLINED RETORTS.

By Charles A. Craven, of Dewsbury.

It has become a difficult matter to select a subject for a paper which has not been more or less threshed out; for, to use a proverbial expression, "there is nothing new under the sun." It does, however, seem that there is still room for some further words to be said on "Inclined Retorts;" seeing that an increasing interest is being taken in this important departure from the older methods of coal carbonization.

Some years ago I visited certain works where this system was in operation, and I must say that I was at the time not very much impressed in its favour. Of late years, however, construction and methods of working have been simplified and improved so, that now we, who have been perforce converted into believers, are fully persuaded that we have good and sufficient reasons for the faith that is in us. If you visit a well-constructed corn-mill, you find that the grain is first delivered in the upper floor; and as it descends from floor to floor by the inexpensive aid of gravitation, the grain is converted into the primary desideratum—flour—and the bye-products are brought to the most convenient position (the ground floor) for their removal. So it is with the coal and its bye-products when dealt with by the inclined retort installations. The system, as it now stands before us, is an efficient, simple, and economical way of dealing with the carbonizing department of a gas-works. That such is the case, I hope to show you by the relation of my own experience at the Dewsbury Corporation Gas-Works. I shall give you our working for the year 1898; so that you may judge for yourselves how far we have been successful.

First let me say in our old retort-house we had 18 beds of through horizontal settings of seven retorts in each bed; the retorts being 20 in. by 15 in. by 19 ft. long. Notwithstanding that our system of firing was direct, we succeeded in getting good heats and a good make of gas to the ton. During the year 1896, when the old settings were in exclusive use, we sold, and got paid for, 8 cwt. 3 qrs. 24 lbs. of coke per ton of coal carbonized; and this was exclusive of the coke and unriddled breeze consumed in providing steam for boilers, driving exhausters, hauling engine and sulphate of ammonia plant. The chimney-shaft is placed in the centre of the retort-stack. It was decided to pull down the section nearest the railway sidings. The demolition of the old stack, roof, &c., was commenced March 18, 1897. This left us with nine beds of sevens intact, which were calculated to supply all the gas required up to about the middle of the following October. The half-section of the house had to be taken up from 20 ft. to 50 ft. high, the roof replaced, and the inclined retort installation completed ready for actual work by the time named.

Dewsbury Inclined-Retort Installation—See pp. 1730-31.

The installation consists of eight beds of eight ⌂ retorts, arches 9 ft. 3 in. wide, division piers 18 in. thick, and end piers 3 ft. thick, total length 90 ft. 6 in. Height of charging floor, 22 ft. above ground level. Height of drawing floor, 9 ft. 6 in. above ground level. The retorts are in three lengths 20 ft. long over all, ⌂-shaped, and tapering from 24 in. by 15 in. at the bottom end to 20 in. by 15 in. at the top end. The producer is at the bottom or drawing side of the bench, so that the hot coke can be delivered direct into the furnace from the retorts. The setting is divided, and the regenerative portion controlled by dampers on each side. The charging floor is composed of steel chequered plates supported by steel girders, secured to the back buckstays and built in the retort-house wall. The charging stage is 25 feet wide, and runs the whole length of the new bench. The drawing stage is 16 ft. 6 in. wide, formed by rolled joists, with red brick arches between filled in with concrete and paved with fire-bricks on edge. The girders are supported by the front buckstays and cast-iron standards fixed to clear the railway which takes coal to the old beds. In the drawing floor, openings are formed so that the coke can be shot below to be stacked or wheeled away. Moveable shoots are provided for directing coke either down below or into the furnace feeding door.

The retorts have mouthpieces on each end fitted up with self-sealing lids on the eccentric screw principle. The gas is taken off from the bottom end; but instead of fixing the hydraulic main in the usual way on the top of the stack, it is carried by girders fixed between the retort-bench and retort-house wall. This arrangement considerably reduces the length of the ascension-pipes; and it enables the hydraulic, foul, and tar mains to be kept clear of the hot bench. A platform is formed along the side of the foul main, reached by a ladder from the drawing floor. The furnaces are well stayed on both sides by vertical and horizontal steel joists, and stays are also fixed across the front and back of the arches; these stays also being used for attaching the top end of the mouthpiece stays. The mouthpiece stays are vertical in both cases, and are much easier to fix than the horizontal stays generally used. They are formed of steel tees and angles, and are well secured both at the top and bottom. Each bed of retorts works into a separate compartment of the hydraulic main, 24 in. by 24 in., with a flat side to which are attached the saddle branches and handhole covers. Each section of the hydraulic main has an improved saddle, which enables the thick tar to run off; and between the seal-regulating valve and the foul main, is fixed a box which separates the tar from the gas, and they are then conveyed in separate mains. A flushing arrangement is provided for each bed, which is simple, yet effective.

There is a continuous coal-storage tank the full length of the bench, 7 ft. wide by 7 ft. 3½ in. deep, with a hopper bottom, and with division plates to each bed. These tanks are capable of holding 90 tons of coal. Each hopper has three measuring chambers, one to each tier of retorts; the slides between being actuated by chain wheels and chains easily worked from the charging floor. The measuring-chambers are also supported by girders from the back buckstay to the retort-house wall with longitudinal joists to suit; and to the bottom is fixed another set of slides and guides, in this case worked by a lever arrangement. Under the measuring-chambers are fixed two lines of rails, on

which the moveable shoots travel; and these rails are supported on one side by brackets on buckstays, and suspended by brackets fixed to the measuring-chamber girders on the other side. Three moveable shoots are provided, one to each tier of retorts; and these can be readily moved to the required position, and have a sliding shoot adapted to deliver the coal well into the mouthpiece. There are also two patent moveable shoots employed, which do away with the necessity of a measuring-chamber, as they combine both in one, and are used in the Dewsbury works for supplying certain retorts with cannel. These are also fixed on the rails and work alongside the other shoots. A platform is constructed alongside the coal-storage tanks, and is reached by a staircase from the charging stage; this staircase also having a landing to get to the top gearing of the elevator. Staircases are also fixed from the ground level to both stages. All the platforms and stages are protected by hand-rails and standards.

The coal-breaking, elevating, and conveying plant is driven by a 10-horse power gas-engine, which is fixed under the railway at the charging side of the bench. The gearing is arranged outside the retort-house, and is driven by a 6-inch belt from the gas-engine shaft. The coal-breakers are driven by a 5-inch belt from a countershaft, and the elevators and conveyors are driven by means of a 3-inch vertical shaft with suitable bevel wheel, spur, and chain gearing. There are duplicate coal breakers and elevators arranged so that either one can be used at will; and the breaker pit is formed of brickwork with cast-iron lining, and is 12 ft. square by 12 ft. 6 in. deep below the ground floor. The breakers are carried by joists, and are of the heavy pattern type capable of crushing hard coal, and each fitted with four rolls. The whole of the breaker pit is covered in by chequered plates supported by joists, and two hoppers are formed over the breakers, so that the coal when shot down from the trucks feeds direct into the breakers. The latter are arranged so that each can feed into either elevator.

The elevator is duplicated, and is fixed outside the gable end of the house supported by a strong framing of joists at the top, and with a platform arranged so that all the working parts can be easily reached. The elevator feeds into a 15-inch push-plate conveyor, which is fixed on the top of the coal-hoppers, and has suitable slides arranged to fill each hopper. These slides are worked from the platform alongside the coal-storage tanks. The coal plant is capable of dealing with 12 tons per hour; and the gearing is arranged so that the machinery can be immediately stopped at several points. The supply of coal is first brought on the gas-works sidings by the Railway Company; then, by means of wire-rope haulage, taken to the end of the siding. They are then hauled back and placed in succession over the shoot leading to the coal-breakers. All the trucks are weighed in gross as they pass over the weighbridge, and again weighed on returning, after being emptied. The movement of waggons is therefore confined to once going forward and once returning to sidings.

The shoot from the railway siding is placed at an angle of 32°, which enables the coal to be dealt with in the most economical manner. Occasionally we have found that the people at the collieries leave in the coal hard wood wedges, pick heads, and other hard substances. A V-stop is put at the delivery end of the shoot, to divide the coal into two streams, as it were, and so enable the youth in charge to have a better chance of discovering in time any foreign substance in the coal. A lever is fixed contiguous to the place where the youth stands, by which he can instantly stop the machinery in the event of any objectionable substance getting into the crusher hopper. The above arrangement for handling and delivering the coal into the bunkers is, I think, very efficient and very economical. The quantity of gas used by the 10-horse power gas-engine has been a little under 30 cubic feet per ton of coal crushed, elevated, and deposited into bunkers. This, at our usual selling price for motive power purposes, equals 0·69d. and at cost price about 0·42d. per ton of coal dealt with.

Our contractors both for the building work and for the inclined-retort installation used their best efforts to push on the work; but you all know what delays occur in waiting for this, that, or the other. Instead of having, as we had hoped, a month to spare before the inclined retorts were actually required, we found ourselves at the last week in October with every available retort going; and, to add to our difficulty, the weather became hazy, followed by a couple of days' fog. Happily we had had fires going for some time under a couple of the new beds, and at last we started gas making. If anyone, without previous experience, imagines that he is going to start inclined-retort work with hands who have never seen these retorts before, and without having trouble of various kinds, he is likely to find himself in error.

The charging-shoots were to adjust; and the men employed had to be taught, among other things, that we did not require all the coal delivered at either the top end or at the bottom end of the retort. Our men employed on the old beds took great interest in the proceedings, and frequently expressed an opinion that the fog would beat us. However, we kept "pegging away," and when we had had a little experience, the finish was that we beat the fog instead of the fog beating us. When the men, who were more ready to jeer than to cheer our efforts, saw that the gasholders were rising instead of still further falling, they wisely resolved that, after all, they wished to take their turn on the inclined retorts.

It is, of course, needless to say anything about working regenerative furnaces in lieu of the old direct-firing system.

I have mentioned the amount of coke sold by us per ton of coal carbonized under the old style of firing. Under the new system we sold, and got paid for, in the year 1898, 11 cwt. 0 qr. 8 lbs.; being 2 cwt. 0 qr. 12 lbs. more per ton of coal carbonized than by the old system. We had a saving on the year's working, in our fuel account, of 2102 tons of coke, which we sold at an average price of 6s. 10d. per ton. In 1898 we carbonized 19,619 tons of coal, and produced therefrom 211,364,500 cubic feet of gas. Many may consider this a miserable price for good coke (for ours is very good). Well, you cannot help that when there are coal pits on every hand, and when your home sales only account for 37 per cent. of the total sales. To those who receive from 12s. to 15s. per ton for coke, such a saving as we have effected would be of great importance. And how does this fuel account of ours work out? Well, gentlemen, it works out as follows on the whole year's experience.

Summary of Saving in Coke.

	cwt.	qrs.	lbs.
Coke actually sold in 1898, irrespective of fuel used for boilers supplying steam for engines, sulphate of ammonia plant, and unriddled breeze made by using coke forks . . . . . =	11	0	8
Sale when using horizontal retorts . . . . . =	8	3	24
Saving per ton of coal carbonized	2	0	12
Total saving, using 19,619 tons of coal . . . . =	2102 tons.		

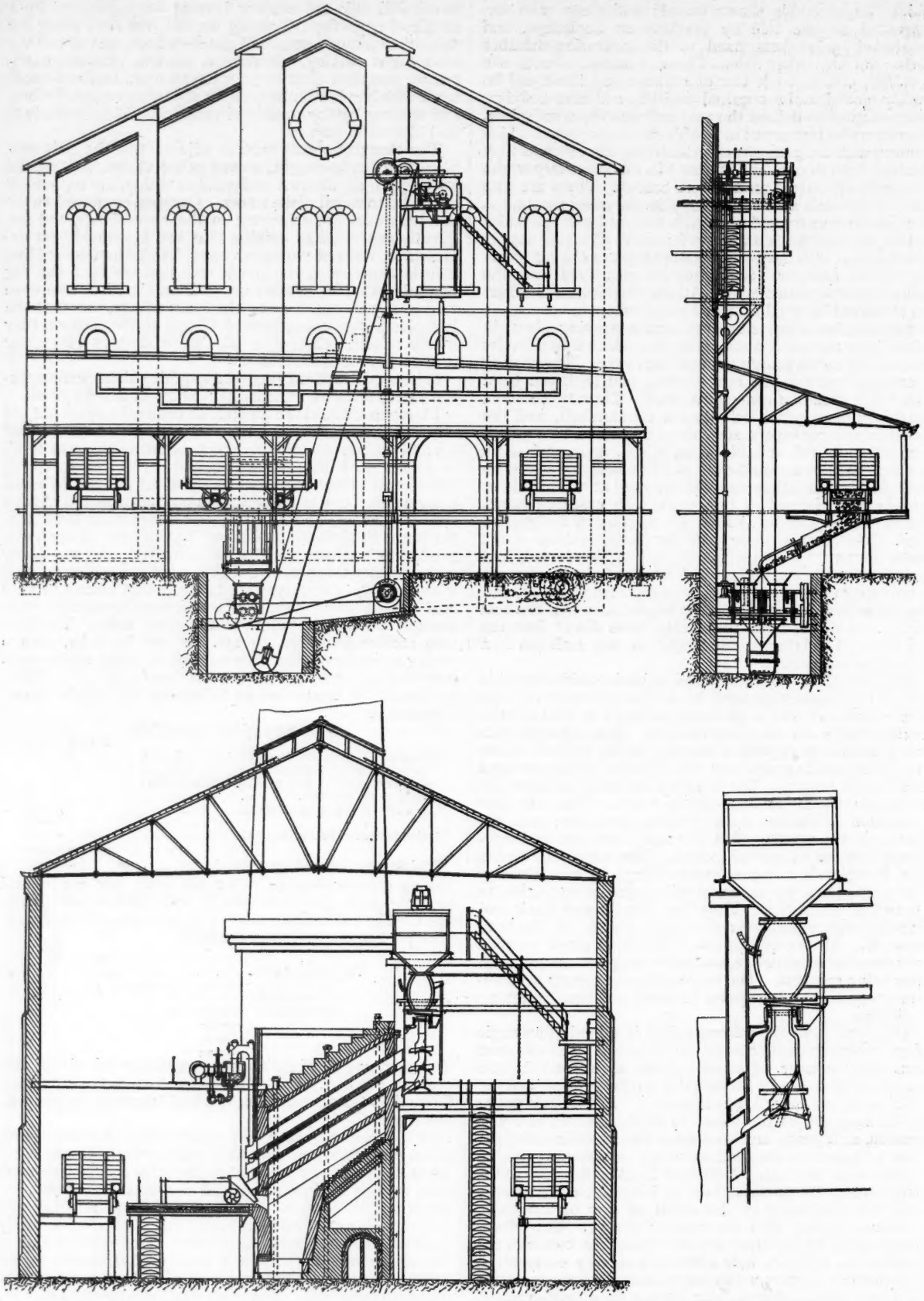
Taking coke production at 65 per cent. per ton of coal carbonized, or 13 cwt. of saleable coke, this would give in fuel used in carbonizing coal 13·67 per cent., or 9·64 lbs. of coke per 100 lbs. of coal carbonized.

	Tons.
Total sales of coke	11,024
By rail traffic . 4766 = 43 per cent.	
By boat traffic . 2232 = 20 ,,	
By local sales . 4026 = 37 ,,	
	11,024

The average cost of carbonizing wages per ton of coal has been, in 1898, 1s. 3·64d. This cost includes retort-house foremen, stokers, coke wheelers, and labour on engine and machinery.

In the summer, when only two beds of inclined retorts are in operation, and two shifts only worked, the cost went up to 1s. 7·95d. Frequently, on the other hand, when more beds were at work, the cost did not exceed 1s. 1·70d. per ton of coal dealt with. Taking the mean at 1s. 3·64d. per ton, there is a marked saving over the old system previously in use at the Dewsbury Gas-Works. During the winter of 1897-8 we had in work six beds of horizontals (seven retorts in each bed) and four beds of inclined retorts (eight retorts in each bed). The horizontals employed 18 stokers, and the inclined retorts required 9 stokers and one engineman. Further, knowing what could be made by the horizontals, we found that the four beds of inclined retorts were producing from 5 to 8 per cent. more gas than the six old beds produced.

The daily production per bed of eight inclined retorts was frequently 130,000 cubic feet. With the full working of the installation of eight beds of inclined retorts, 1 million cubic feet of gas was often exceeded. This is giving what can be done, and was done, when the conditions

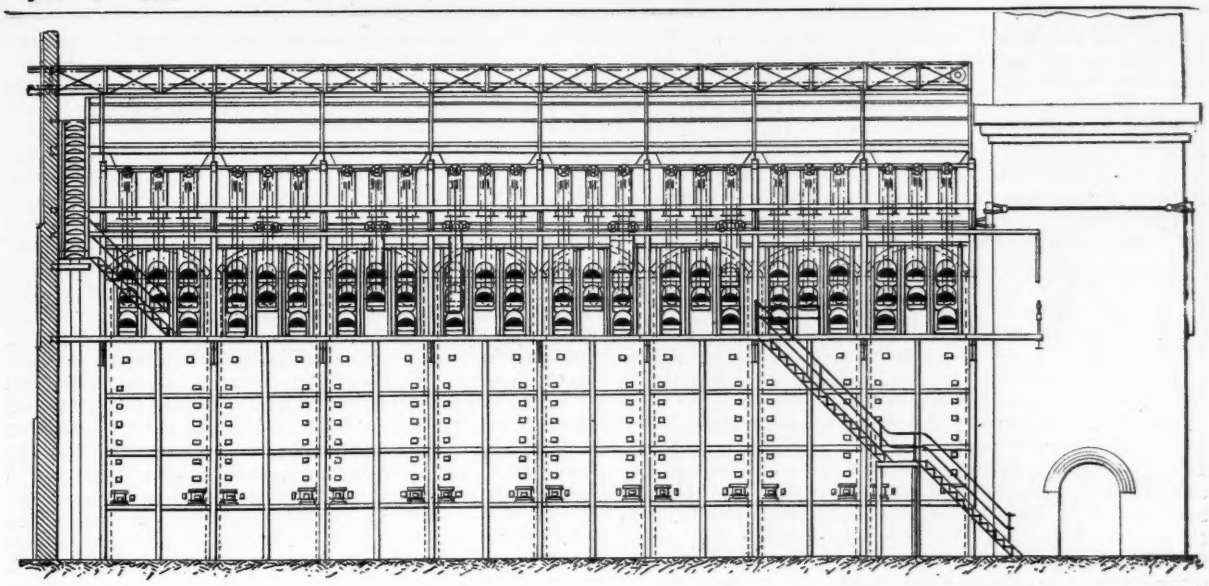


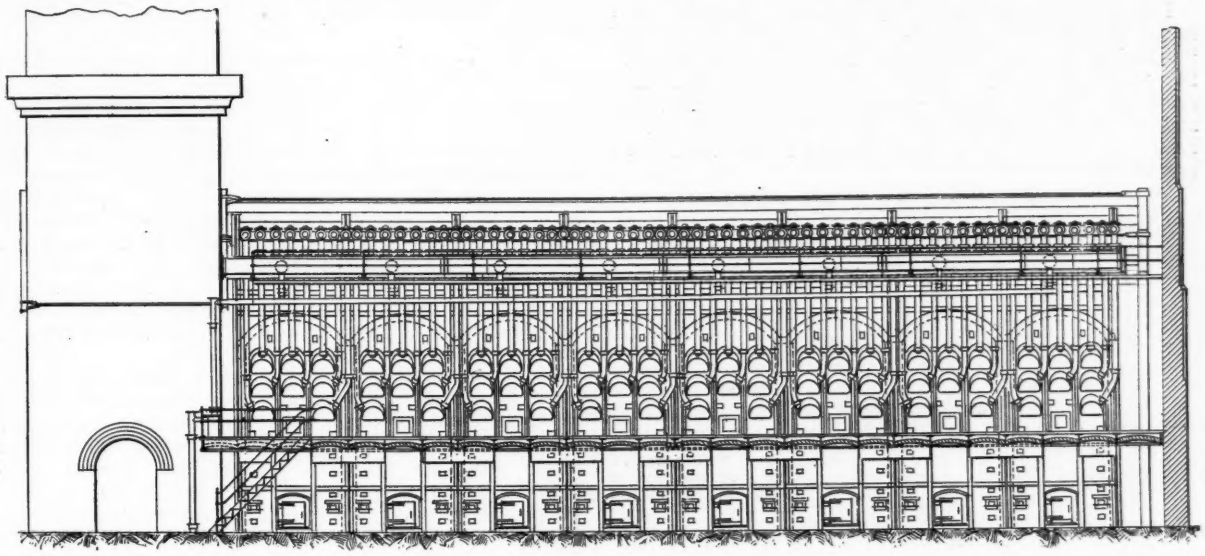
of dry coal and steady working were obtained. In some larger works, where not less than four beds can be put on at once, a more favourable average cost would be obtained. The heats obtained have been most satisfactory, and easily adjusted. That we are utilizing the fuel to advantage is evidenced by our low fuel account, and by the appearance of the main flue leading to the chimney-shaft.

In order that this paper may not be unduly lengthy, the following points are submitted in paragraphs. As there are probably many who have not had any acquaintance with the working of inclined retorts, or regenerative firing, the writer ventures to give them.

In Starting Retorts.—Partly draw the dampers, primary and secondary air slides, put on steam or water supply as required, and increase above when heats want raising. Leave furnace cover off until ready for pushing heats.

Putting Down Retorts.—Leave furnace cover off, let the dampers be partly open, and reduce supply of water, or steam, to producer furnace. When the bed is cool enough, close dampers, slides, &c.





Temporary Suspension of Work.—Stop firing and nearly close dampers. Keep the requisite quantity of water or steam flowing to prevent fusion of fire-bars. Keep retort-mouthpiece lids on discharging floor tightly closed, and retort-lids on charging floor very slightly open. When resuming work, adjust dampers and air-slides as before.

Everyone will have to find out himself what amount of openings are required in dampers and air-slides, as the amount of chimney draught will vary in different gas-works; and even beds in the same stack also vary, sometimes very considerably. Have fixed times for the careful inspection of machinery. At the Dewsbury works, it is found necessary to flush the outlets from the hydraulic main at least twice a week, which is done with ammoniacal liquor in preference to using fresh water.

At the beginning of working inclined retorts, it was found that our pipes for conveying tar and ammoniacal liquor to the well were too small, and had too many bends in the course. We had therefore to lay an 8-inch direct pipe, at a most inconvenient time, and succeeded in reducing the number of angles from seven to one. Since doing this work, we have had no trouble in getting away the tar and liquor to the well. If the charge of coal does not arrive at the stop-plate, blocked ascension-pipes will probably follow. Since adjusting the action of the charging shoots, we have had fewer cases of stopped pipes than we had with the horizontal settings.

The most reliable men should be placed on the charging floor, and it is well not to change these men from that position. With experience and repeated practice, an intelligent charger becomes acquainted, as it were, with his retorts, and knows which require more or less force in sending down the coal. The faces of mouthpieces and lids are scraped over before being charged; and it has been found advantageous to keep a bucket of common oil in paste, and smear the face of the mouthpiece by means of a turks' head brush. This softens the hard tar and reduces blows when the lids are closed.

For greater convenience in pointing the joints, the retorts which are now in three equal sectional lengths, and with the joints at right angles, will in future renewals be as follows: End section joining mouthpiece each 5 feet long and the middle section 10 feet long, and the joints splayed so as to allow them to be built in centre of division walls.

The writer is of opinion that the storage capacity of bunkers and measuring-chambers combined, should equal one full day's requirements. To prevent the smudge and round coal being unequally divided, it is desirable to have three drop-slides at the bottom of the conveyor for each bunker. At the Dewsbury Gas-Works, there are three points where levers are placed, any one of which will at once stop the crushers, elevators, and conveyors.

(1) Near the gas-engine,
(2) Near the crushers, and
(3) At the platform in front of the coal-bunkers and conveyors.

It is much more pleasant to speak of successes than it is to detail misfortunes. We have had three breakdowns of our elevators; and it was only on the third occasion that the correct solution of the cause was arrived at. Our duplicated elevators are in a square case made of steel sheets. This casing serves to prevent the waste of the coal dust, and is of the same internal dimensions from top to bottom. It was found that the accidents were caused by pieces of hard cannel projecting over the edge of the buckets, as they began to ascend, and striking against the bottom edge of the casing. The two edges would be ½ inch

apart, and the strain in shearing the projecting pieces snapped one of the links and brought down the whole length of buckets and chain. Of course, these accidents occurred, as most gas-works accidents usually do, when the daylight was nearly or altogether spent. Having found out the real cause of the trouble, the outer sheets of the casing were splayed outwards, so as to allow sufficient space for the charged buckets to turn and ascend freely. This, and the periodical inspections, have proved an efficient remedy for a very trying difficulty. On one of these occasions, we had to hurriedly rig up tackling and lift about 30 tons of coal from the railway trucks to the bunkers, before we got the breakdown made good.

Dewsbury is a manufacturing centre, and the gas-works have only 80 per cent. gasholder storage of the maximum day's make. So you see that it is doubly important in this case to avoid, as far as may be, all chances of a breakdown. As before stated, at the Dewsbury works the building was carried the full height of 50 feet from the ground line. In the opinion of the writer, this is far preferable to sinking the furnaces and coke drop below that line, and then, by some means or other, having to get the coke up again. On the one hand some cost is saved in walling; but, on the other hand, you have the advantage of getting your coke away on the same level as your yard.

I do not claim that the following labour schedule is perfect. My friend Mr. Bower has a very simple way indeed of "manning" his bed—*i.e.*, "one man, one bed of retorts." Still, when you come to work two beds only, the one-man system of working entails "such a getting up (and down) stairs," that I think our way is, upon the whole, preferable. At least, our men preferred our method to the other, and I agreed with their views.

The Schedule hereinbefore referred to :—

NUMBER OF STOKERS TO BE EMPLOYED ON THE INCLINED RETORTS.

For 2 or 3 Beds .	One man on charging floor. Two men on discharging and coke floors . . .	Two shifts per day Men to take last round half hour earlier, and to be allowed to leave work on completion of same.
For 4 Beds . .	One man on charging floor. Two men on discharging and coke floors . . .	Three shifts per day. Hourly charges if necessary, when more than 4 beds are at work.
„ 5 or 6 Beds .	One man on charging floor. Three men on discharging and coke floors . . .	
„ 7 or 8 Beds .	Two men on charging floor. Four men on discharging and coke floors . . .	

It is only just to say that we have a good and respectable class of men employed at the Dewsbury Corporation Gas-Works; and to them must be given a portion of praise for the measure of success that we have attained. Had it not been that the work had been pushed on from beginning to finish, we should, in the winter of 1897, have been in a sorry fix. I will close my paper by again urging upon those who are putting in inclined retorts to see that they have plenty of time in which to execute the work, and that time is added for the same to dry and consolidate.

Discussion.

Mr. JOHN WEST (Manchester) said the paper was very interesting, and contained a good deal of valuable information. He might also congratulate the author on his working of the system. He seemed to have sold a large quantity of coke per ton of coal carbonized; for even on the old system, he sold 8¾ cwt. per ton, so that he had a good system to beat. He had, however, succeeded in doing what most people did who had a good type of regenerator setting, and sold about 2 cwt. of coke more per ton of coal carbonized. The position of his hydraulic main and many other parts of the plant seemed to have been well thought out. Still there were some things on which further information was still needed. This was a most important question, and one which was receiving a great deal of consideration at the present time. Some points were yet left in doubt; and unfortunately these doubtful points were not touched upon in the paper. So far as it went, it was good; but it was very incomplete. Any system of carbonizing which was compared with the old (or any new) system should give the complete facts and figures throughout in detail. On some of these points, he (Mr. West) had asked questions before—for instance, the difference between the make of gas per ton of coal carbonized on the old system and the new; what difference, if any, there had been in the illuminating power of the gas made; what rate of wages were paid to the workmen; and so on. He was much interested in a very large installation of inclined retorts which was now going up in London. A great many men were trying to tackle these questions; and only about a week before the subject was discussed by the Institution of Civil Engineers, when he gathered from Mr. Carpenter, who had been fitting up an installation at the Bankside Gas-Works, that they were satisfied with the mechanical arrangements and the plant generally, but that they could not get the same make of gas per ton that they did formerly. The deficiency was about 300 cubic feet per ton. Now he knew the old works at Bankside, and one would naturally have expected that with an entirely new system, and everything of the best description, better results would have been obtained. Some said better results had been obtained in certain cases with inclined retorts; but the question was still left in doubt, and he (Mr. West) would suggest that anyone taking up this subject in future should give full particulars as to make of gas per ton and so on. There should also be a full statement of the cost of the plant, wear and tear, and everything connected with it. Personally, it was immaterial to him what system came to the front; he only wanted to see the survival of the fittest.

Mr. C. E. JONES thought they might well compliment Mr. Craven on the trouble he had taken to give the details of his installation with a minuteness and precision which put an auctioneer's catalogue into the shade. Some information was given as to the cost of working; but he should like it supplemented by the cost of the installation, showing at what figure it worked out per ton. He had been present at the conference of engineers referred to by the last speaker, and could corroborate what he said in respect to other people's experience not being so favourable as that of Mr. Craven. In some cases, he noticed that the wages of the foreman was included, and in others not; and he thought all expenses should be included in the cost per ton for purposes of comparison.

Mr. ISAAC CARR (Widnes) confessed to some disappointment in listening to the paper. He thought the author must have written it in a great hurry, and that if he had had time to re-write and well consider his facts, much of the matter would probably have been omitted. It went without saying that if a gangway were put up with a spiral staircase it was necessary to put a handrail round it. Information of this sort was not necessary. Again, with regard to the instruction as to the working of dampers, the author explained that this was not exactly meant for the older members; but for his (Mr. Carr's) part he should consider the Gas Institute a very poor affair if there were any section of its members to whom the information contained in that paragraph was applicable. It was like telling an engineer that, when he wanted to start his engine, he must open the valve. He had tried to get some idea from the paper what the system described was really doing for the Dewsbury Corporation; but he entirely failed to do so. Again, figures such as those giving the quantity of gas used by the engine for the elevator, and working out at about 0·4d. per ton of coal elevated, gave no idea of the real cost of elevating. They wanted to know what it really cost to elevate the coal. The paper was absolutely indefinite from beginning to end. He hoped Mr. Craven would take these remarks in good part; but he (Mr. Carr) thought a paper on such a subject should really leave on the mind some idea of what the system was doing—what it cost, and how it compared with anything done before.

Mr. R. PORTER (Elland) said he intended to ask several of the questions already put by Mr. West—especially with regard to the yield of gas and the increased cost of the installation over the horizontal system. He would be glad if Mr. Craven would say what was the yield of gas per ton of coal for the period under review. One important point which seemed to be made clear by the paper was the absolute necessity of employing skilled labour. The advocates of the inclined system had always maintained that no skilled labour was required; but from beginning to end of the paper, it was evident that skilled labour was indispensable. The production of coke was very high—chiefly because Mr. Craven used a coal which gave a large yield; but he (Mr. Porter) did not think it was more than was actually obtained from regenerative furnaces as applied to ordinary

settings. The author gave the cost of labour as very low—1s. 3·64d. per ton; but there would have to be a considerable sum added to this amount for interest on increased capital expenditure and increased cost of renewals.

Mr. William Carr (Stalybridge) did not know whether Mr. Craven laid special claim to the sale of coke as being an advantage gained from inclined retorts. If so, as Mr. Porter had pointed out, he was not doing anything better than he (Mr. Carr) was doing with horizontals, for he was selling 11½ cwt. per ton with regenerative firing. He did not assume, however, that he was using such a small quantity of coke as Mr. Craven. When coke was slaked, he was of opinion that more than 13 cwt. per ton could be obtained. He would like to have had some information on the several points Mr. West had asked for, and also as to the make of gas per ton and per mouthpiece.

Mr. J. P. Leather (Burnley) did not know whether he ought to answer any of the questions put to Mr. Craven; but having had considerable experience in inclined retorts he might repeat the answers he had on previous occasions given to some of Mr. West's questions. With regard to the make of gas per ton and the illuminating power, he did not see why there should be, if the retorts were properly worked, any difference between inclined and horizontal. He certainly should not claim any advantage for the inclined retorts; but, on the other hand, there was no disadvantage in that respect. He had both inclineds and horizontals at work, and had at different times for the last few years had a month or two's experience of one kind only; and they could not find any difference which could be attributed to the horizontality or the incline of the retorts, either in make of gas or in illuminating power. Last year they made 10,120 cubic feet per ton, which, of course, did not convey much information, because it depended on the quality of the coal used. Their gas was 17¾-candle power, using a small percentage of cannel. They made this quantity and quality for four or five months, using horizontals only, and for another portion of the year when using inclined retorts only. With regard to the cost per ton, they had the manual machines brought out some time ago by Mr. West, and found there was an advantage (taking a period which was carefully watched) of about 8d. per ton for the inclineds over horizontals. Many people found a much greater difference than this; for instance, Mr. Shoubridge last year gave a much better result than he had obtained. Mr. Craven had a much lower cost; but then they paid very high wages—probably higher wages to stokers than most of those present. They paid about the same rate of wages to men working on horizontals as on inclined retorts. With regard to the capital account, the expenditure varied very much by different persons. One man would spend twice as much per retort as another one in putting up an ordinary retort-house, because he made the house unnecessarily big or high, or put more massive walls, and so on. The cost, therefore, was very difficult to compare. But taking their own retort-house, being uncertain at the time it was built whether they would use horizontal or inclined retorts, it was made 3 or 4 feet larger in span than it would have been otherwise. When it was decided to put in inclined retorts the height of the house was increased 2 feet only on the original design. They had two sets of 15-feet retorts back to back; consequently there was 30 feet length of retorts, where if they were put horizontally they would only have 20 feet. In this way they had half as much again of length in the retort-house, and were making more per foot of retort than they would have done with horizontals. But this again was nothing to go by, because there was a different system of firing. He thought, however, the increased length of retorts per foot of the retort-house made up for any increase of expenditure in going up higher.

Mr. D. Terrace (Middlesbrough) suggested that if Mr. Craven were re-arranging his plant, it would be well if he made the casing of the coal-conveyor in two entirely separate parts, so as to obviate any trouble such as was described in the paper, and which necessitated him elevating by hand the coal required on one occasion for the entire installation.

Mr. Craven, in reply, said if there were any difference in his make of gas per ton, it was in favour of the inclined retorts. The average make was 10,773 cubic feet. With regard to the illuminating power, it was somewhat better than before. As to the rate of wages, they paid 5s. 3d. per shift of eight hours; there being three shifts except in summer-time, as he explained before. He paid all the men alike—those on the top, the middle, and on the floor wheeling; and they paid better wages than most people. With regard to the plant, he could not give the cost of the building part; but without taking into account any expense for royalty, the fittings and machinery complete came to £57 2s. 7d. per mouthpiece. Mr. Jones had referred to his leaving out the wages of the foreman in one instance and not in another. In one case it was a comparison between working six beds of old retorts and four of the new inclined retorts at the same time; and as the foremen were there, he had just left it out in both cases. He made 5 to 8 per cent. more gas with ten men, including the engineman, than with eighteen stokers, leaving out the foreman in both cases. Mr. Carr wanted to know what was the saving to the Dewsbury Corporation. It had been very considerable; and they were so satisfied with the financial results that, whenever they had a further extension to make, there was no doubt they would put up inclined retorts. But it would be manifestly unfair to take their case as typical; because they had a small production in summer when sometimes the men had an interval of an hour-and-a-half to two hours with nothing to do. Therefore, it was not possible to work so economically as when more than three beds were going. The comparison ought to be at 1s. 1d., or (say) 1s. 2d. per ton of coal carbonized, which was a very great saving as compared with the old system, which cost 2s. 8d. to 2s. 10d. Mr. Porter said it was manifest that skilled labour must be employed; but he could only say they employed exactly the same men as they had about the other beds. They were all either labourers or stokers. No doubt they were skilled stokers; but they paid everyone engaged in stoking alike. If there was a man short on the top floor, they put on a man from the middle floor to get him accustomed to the work. What he wanted to emphasize was that the best man must be put on the charging floor, because he then got to know his retorts. As was well known, some retorts required to have the coal thrown down them much quicker than others; and when a man once got accustomed to the peculiarities of his retorts, better results were attained. With regard to the coke made and sold, 13 cwt. of saleable coke was as much as he could get out of the coal they at present used. It was good coal, with from 12 to 14 per cent. of cannel, yielding not more than 11 cwt. of saleable coke; and when he reckoned a gain of 65 per cent. or 13 cwt. per ton of coal, he was certainly putting the case against himself. Mr. Carr spoke about getting 11½ cwt. of coke for sale; but besides that, he (Mr. Craven) had to keep two boilers going—one night and day for twelve months, and another night and day for six months—and for all the firing of which he had not taken any credit whatever. If he had done so, and for what coke was used maintaining steam for other purposes (as he had a right to do), the result would have been 12 to 12½ cwt. per ton of coal carbonized.

Mr. West suggested that this was on the assumption of 13 cwt. of coke being produced per ton; and he thought everybody got more than that. It depended upon its saturation with water.

Mr. Craven said he never got more than 13 cwt. of saleable coke; though there might be some coal that would give more. Taking the average all round, he thought it was a very liberal quantity. The question might arise, What was the reason they got such good results? He had looked at other settings elsewhere; and in the main flue leading to the chimney the colour of the heat was either a dark or a clear red, and on taking the temperature in that case (which was a very good setting at a large works), he took it he must have at least from 1000° to 1200° Fahr. in the main flue. Now before coming to London he got a pyrometer, and put it close to the entrance where the retorts were working; and the temperature registered was 270° Fahr. It was not red at all, but quite black. There were gentlemen present who had looked through the flue on his invitation, and he asked them to admire the prospect. They had told him they could not see anything, which was quite correct, because there was nothing to see; it was all quite black, and he thought such a temperature was exceedingly satisfactory. It showed that they were getting the best possible results out of the fuel. Mr. Terrace had made a suggestion that he did not see any necessity for adopting. In his case the steel casing of the elevators was divided in the centre, and they had altered

the bottom of the casing in the way he had described in the paper. The result was very satisfactory. He did not see why the wear and tear of his inclineds should be any greater than with ordinary retorts. They had worked the same beds of retorts continuously since October, 1897; and they could work them longer if needed. But they were going to renew some of them, because they had had to start these beds in 1897 when they were insufficiently dried and consolidated. The work was done well, but rather hurriedly, because it was a question of supplying the town with gas or letting it go in partial darkness, and so they could not afford to wait.

NAPHTHALENE DEPOSITS; THEIR CAUSE AND PREVENTION.

By John P. Leather, of Burnley.

The trouble caused by naphthalene deposits presses very irregularly on those responsible for the conduct of gas undertakings. There are probably some who, by experience, know nothing of it; while the problem of how to deal with it, has haunted others day and night. Not the least irritating part of the matter is the apparent eccentricity of the naphthalene, which often seems controlled by no law but its own sweet will. Nevertheless experience in all branches of science tends to show that even the most complex problems may be explained as regards their most prominent characteristics by extremely simple laws. So no doubt in the case of naphthalene it is only necessary to carefully examine the phenomena of its formation and conduct under conditions where exact observation and experiment are possible, and its behaviour under the more complex conditions of gas manufacture and distribution will be largely understood.

Under the influence of high temperatures, complex organic substances such as coal are decomposed, with the formation of substances of a simpler character. Many of these simpler substances are themselves decomposed if the temperature is sufficiently increased. Therefore, if the temperature at which coal is carbonized be raised, the tendency is to reduce the number of substances obtained, until none are left but those which are not liable to decomposition.

When the distillation is effected at the low temperatures used in the distillation of shale, for instance, a large part of the product consists of hydrocarbons of the paraffin and olefine series. In these, the atoms of carbon are combined in open chains, which at a red heat are broken up into simpler forms, with the separation of small quantities of carbon and hydrogen. Of the simpler forms the most stable is marsh gas (CH_4), which with hydrogen adds to the make of gas. Some benzene is also formed, probably by the union of molecules of acetylene.

The same cause which breaks up the open chains of the paraffins also breaks up the side chains of the hydrocarbons of the benzene series, increasing the quantity of benzene at the expense of the toluene, xylene, and cumene. The effect of this again is to diminish the quantity of the tar and improve the quality of the gas by adding benzene, which has higher enriching power.

Benzene, however, is not the only closed-chain compound which is stable at high temperatures. There are others, of which naphthalene, anthracene, and phenanthrene, are the most prominent. The two latter, though having their commercial importance in the tar, are too small in quantity, and boil at too high a temperature, to affect the gas. Naphthalene, however, is produced in larger quantity than any other hydrocarbon except benzene and marsh gas; and being in such excess, is able to saturate the gas with its vapour.

In order to understand the behaviour which naphthalene may be expected to exhibit in gas, it may be well to reiterate some of the well-known laws of mixtures of gases and vapours. If a gas is in contact with a liquid, the liquid evaporates until the gas contains such a proportion of vapour as would by itself give a certain pressure which is known as the vapour tension. This vapour tension varies with the temperature. Given the pressure, temperature, and vapour tension of the liquid at that temperature, it is not difficult to calculate the quantity of the vapour which a gas can contain. When dealing with a mixture of liquids of different vapour tensions, the proportions in which the different constituents will be contained in the gas is affected by their proportion in the liquid and their solubility in one another, as well as by the individual vapour tensions. Other things being equal, the substance having the higher vapour tension will be present in larger quantity.

When a gas saturated with a mixture of vapours is cooled, the tendency is for the vapours of highest boiling point and lowest vapour tension to separate out first; but smaller quantities of those with lower boiling point and higher vapour tension separate out at the same time. The gas issuing from a retort is in this condition, giving a distribution of the hydrocarbons between the gas and the tar as shown in Table I., which is taken from a paper by Mr. W. Irwin, read before the Manchester Section of the Society of Chemical Industry, in February last.

Table I.

Condensable Hydrocarbons in Coal Gas. (W. Irwin.)

	Boiling Point, Centigrade.	In Gas. lbs.	In Tar. lbs.	Total. lbs.
Benzene	80·4°	18·00	0·8	18·80
Toluene	111°	6 00	0·7	6·70
Xylene	137°–142°	0·40	1·0	1·40
Cumene	163°–169°	0·10	0·3	0·40
Naphthalene	218°	0·15	13·0	13·15
Phenol	184°	..	1·0	1·00
Pyridine 90 per cent.	120°–140°	..	0·3	0·30
Anthracene	360°	..	0·3	0·30
Phenanthrene	340°	..	1·0	1·00
Higher phenols and various heavy oils	200°–400°	..	22·7	22·70
Pitch	—	..	93 0	93·00
		24·65	134·1	158·75

It will be seen that the benzene and toluene, which have a higher vapour tension at ordinary temperatures than water, are found principally in the gas; while the hydrocarbons having lower vapour tensions, are found chiefly in the tar.

An analysis of the Burnley gas, after passing through a Livesey washer, but before the extraction of the ammonia, gave the following results:—

Analysis of Burnley Gas.

	Weight in 10,000 Cubic Feet. lbs.
Benzene	15·80
Toluene	5·30
Xylene	1·45
Cumene and other compounds boiling between 300° and 380° Fahr.	0·32
Naphthalene	0·13

In the paper above referred to, vapour tensions of the hydrocarbons under consideration were given, as shown in Table II.

Table II.

Vapour Tensions at Various Temperatures. (W. Irwin.)

—	10° C. mm.	15° C. mm.	20° C. mm.	25° C. mm.
Benzene	48	61·00	79	—
Toluene	—	19·40	—	—
Xylenes 3	—	6·30	—	—
Cumenes 3	—	1·50	—	—
Naphthalene	—	0·03	—	0·08

Taking this table in conjunction either with the figures in Table I. or with the above analysis of Burnley gas, it will be found, on making the necessary calculations, that at 60° Fahr. about 25 per cent. of the gas is saturated with hydrocarbons other than naphthalene, and that only one-tenth of a pound of naphthalene is required to complete the saturation of 10,000 cubic feet of gas. This theoretical calculation is confirmed by direct determination. I have made several determinations of the naphthalene in the gas on the works at Burnley. The largest quantity found was at the rate of 0·2 lb. of naphthalene per 10,000 cubic feet. The gas in this case had not been cooled below 70° Fahr., at which temperature, calculation shows it to be capable of containing about that amount.

If the gas is subjected to a lower temperature after leaving the works than it has previously experienced, there will be a deposit in the mains. This deposit will consist chiefly of those substances having the lowest vapour tensions; naphthalene in the largest quantity, cumene in less quantity, and xylene in less quantity still. There would be no inconvenience caused by this deposit if it were liquid, as in an undertaking making 500 million cubic feet per annum

the quantity would not be more than two or three bucketfuls per week. The difficulty arises from the fact that naphthalene is a solid at the ordinary temperature, melting at about 180° Fahr. and crystallizing in thin plates, which occupy a large amount of space in proportion to their weight.

If the quantities of cumene and xylene in the gas were only slightly greater, sufficient of these might be condensed at the same time to dissolve the naphthalene and let it run to the nearest syphon. But, as already pointed out, they are reduced by the higher temperature at which carbonization is now carried on, and some other method must be devised to overcome the difficulty.

It is evident that in attempting a cure, one or both of two things may be aimed at: (1) The prevention of deposition by withdrawing naphthalene from the gas, so that at the lowest probable temperature the point of saturation will not be reached; or (2) the deposition of the naphthalene in a liquid form by adding something to the gas to cause the deposit to assume that form.

Various modifications of plant and means of working have been claimed as cures for the naphthalene trouble. Those which consist of variations of the condensing plant will be often found of local value only. When attempted to be applied elsewhere, the different conditions as regards quality of coal, temperature of carbonization, &c., render the methods inapplicable.

If, however, the gas be washed with a liquid which dissolves the naphthalene out of the gas, the possibility of its after-deposit is very evidently prevented. It may be suggested that such a washing would deprive the gas of other constituents which give it illuminating power. It is, however, found in practice, as indeed might be deduced from theoretical considerations, that the quantity of benzene and toluene dissolved from the gas is very limited. For instance, in washing gas to obtain benzol, as is done in carbonizing and coke works, by means of creosote oil, it is not found possible to obtain more than 6 per cent. of benzol in the creosote. If the creosote contains much more than 6 per cent. of benzene, the gas will take up benzene instead of losing it.

Of processes which have attracted much notice as cures for the naphthalene trouble the most prominent is that of Messrs. Botley, which has been in use for some time at Hastings. The details of this process are probably familiar to most of the members of the Institute. Briefly it consists of filling the gas just before it leaves the works with an exceedingly fine mist of paraffin oil. The arrangement is well designed, and works with great ease, reflecting much credit on its inventors. The mist is of such a fine character that a great part of it is carried through the whole canalization of the district, even to the consumers' burners.

All mists fall if sufficient time be given; and as the spraying apparatus breaks up the oil into particles of varying size, no doubt the larger ones fall first. There is usually a considerable deposit in the first 150 yards of main before the gas actually leaves the works. This is collected and used over again until the specific gravity reaches ·850; that of the original oil being ·800.

In communications which have been made public by Messrs. Botley, they appear to have been under the impression that this oil had not dissolved any naphthalene out of the gas; and their explanation of its action was not very satisfactory. By the courtesy of Mr. Botley, a short time ago I not only saw the process at work, but was kindly permitted to take a sample of this oil; and on analysis, I obtained the following results:—

Analysis of Deposited Oil from the Hastings Works Main.

5 per cent. boiling below 212° Fahr., chiefly benzene.
2 ,, between 212° and 250° Fahr., chiefly toluene.
5½ ,, between 250° and 300° Fahr., chiefly xylene.
10½ ,, between 300° and 380° Fahr., of which nine-tenths were cumene or other substances of the benzene series.
About 5 per cent. by weight was naphthalene.

The quantity of this oil recovered amounts to 0·023 gallon per 10,000 cubic feet of gas, which corresponds to an abstraction from the gas of the following quantities per 10,000 cubic feet:—

	lb.
Benzene	0·009
Toluene	0·004
Xylene	0·011
Naphthalene	0·010

As the quantity of benzene in Hastings gas is probably not less than 14 lbs. per 10,000 cubic feet, the abstraction of less than one-hundredth of a pound cannot have any measurable influence on the illuminating power. It will be seen that the oil has taken out quite as much naphthalene as benzene, although the quantity of benzene in the gas exceeds that of naphthalene more than 1000 times.

In the distribution mains there is a further deposit of oil, the quantity of which has not been determined. This also contains naphthalene. The conclusion therefore is that the Hastings process removes, by solution in the deposited oil, about one-fifth of the naphthalene from the gas. This is probably of itself sufficient to overcome the naphthalene difficulty under ordinary circumstances; but if the gas is subjected to an exceptional reduction of temperature, it is evident that any deposit of naphthalene is sure to be rendered liquid by the oil mist still left in the gas.

A comparison of the analysis of the original Tea Rose oil used at Hastings with the oil deposited after use, discloses an interesting fact, which might indeed have been expected from the well-known laws of solution of vapours in gas. Tea Rose oil begins to boil at about 250° Fahr., and 50 per cent. of the oil boils below 460° Fahr. The deposited oil only contains about 45 per cent. boiling below 460° Fahr.; and nine-tenths of this portion consists of aromatic hydrocarbons not originally contained in the Tea Rose oil. It follows from this that 100 parts of oil sprayed into the gas give up 45 parts in the form of vapour, and absorb 40 parts of benzene and other aromatic vapours from the gas. The addition of these paraffin vapours to the gas necessarily assists further to prevent naphthalene troubles. A considerable portion of them have a boiling point approximating to that of naphthalene. If the gas suffers a reduction of temperature during distribution, these vapours will be partially condensed, and thus serve to keep any deposited naphthalene in solution.

The addition to the gas of hydrocarbon vapours of the paraffin series having a boiling point approximating to that of naphthalene, plays an important part in the process adopted at St. Helens by Mr. Samuel Glover. In this case a portion of the coal is carbonized at a low temperature; and the gas therefrom is mixed, while hot, with the already cooled gas from high-temperature retorts. The result may be expected to be similar to that at Hastings. The hot gas containing a great variety of hydrocarbons partly in suspension and partly in the form of vapour, a portion of the naphthalene will be dissolved out in the hydrocarbons condensed from the gas, and the portion not immediately dissolved will, if deposited at all, be deposited in a liquid form. It is, however, simpler to dissolve out the naphthalene at once on the works, and thus preclude the possibility of any trouble afterwards; and I have experimented successfully in this direction during the past six months. Having a scrubber at liberty, creosote oil was pumped through, using the same oil over and over again, until it ceased to take up naphthalene from the gas. Two hundred gallons of creosote will dissolve the naphthalene out of more than 10 million cubic feet of gas. At the time when the experiment was first tried, a number of men had to be employed doing little else than attend to consumers' complaints of stopped services, in addition to which frequently more than 100 lamp services required clearing out per day. On using the creosote, the complaints quickly ceased, only to occur again, however, about twelve days later, when the oil had absorbed about 16 per cent. of naphthalene. On several occasions the oil has been worked up to saturation point, and fresh oil brought into use as soon as the reports of small lights at the public lamps came in. Each time after changing the oil, the stoppages have rapidly been cleared.

Used by itself the oil absorbs benzol from the gas equal to about 6 per cent. of its weight. By adding a small quantity of benzol to the oil before using, this action is prevented. The illuminating power of the gas is taken on the works by a jet photometer every half hour; but no effect has been observed on bringing the oil into use. By using a suitable mixture of benzol with the oil, a ready method is obtained of enriching the gas to any required extent, and variations of illuminating power are partially neutralized.

After use the oil is pumped into a still; the benzol and light oils being distilled off by means of steam. By further application of live steam, the naphthalene can also be distilled over and added to the tar in the tar well. The creosote left in the still can then be used over again, mixed with the light oils.

I have tried various kinds of oil for the purpose. Prices and local circumstances may cause one kind of oil to be preferable to another; and the details of working may be varied. In any case the cost is not very great and the trouble is slight; the whole system working almost automatically.

Instead of passing the oil through a tower scrubber, it would be preferable to use a washer-scrubber, which could be kept in efficient work by a very small stream of oil. The gas would then come into contact with oil containing naphthalene first, and finish with fresh oil. In this way the oil could be worked up to saturation point, and thus absorb the whole of the naphthalene from a larger quantity of gas.

In conclusion, I must express my indebtedness to Mr. W. Irwin, at whose suggestion I first tried the method I have described, and to my Works Analyst, Mr. F. W. Harris, for his assistance in the various analyses.

Since writing the foregoing, I have had my attention called to the able and original paper brought before the Institute two years ago by Messrs. Young and Glover, in which they recommend the extraction of naphthalene from coal gas by methods very similar in principle to that indicated in this paper. As I have already stated, the idea was suggested to me by Mr. Irwin, who I believe was the first to extract the condensable constituents of coal gas on a commercial scale, and who has had long experience in their extraction both at carbonizing works and at modern coke-ovens. This experience proved the effect of high temperatures on carbonization to be as I have stated. It was simply a matter of arranging the rate of his run of oil as to whether he extracted only the heavier or the whole of the condensable products of the gas. He, of course, was able to bring his experience to bear in testing the actual quantity of the various products of condensation in the gas; this being absolutely necessary for placing the process on a practical footing. It is also a side of the question which previous experimenters have not touched upon, if indeed we except Dr. Leitner, whose paper has recently appeared in the "JOURNAL OF GAS LIGHTING,"* but whose figures relative to the amount of naphthalene in coal gas are much too high—being far above what its vapour tension would allow if it were the only condensable constituent of the gas. I simply make this statement to show how we arrived at the process independently, and also brought the same to a practical conclusion.

Discussion.

Mr. C. F. BOTLEY (Hastings) said that it gave him great pleasure to be present (by invitation) to take part in the discussion of this admirable paper, which must be very interesting to those who had experienced difficulty with naphthalene. The author had gone very closely into the Hastings process, and although his results were not what he had expected—as he had explained in correspondence with him—he (Mr. Botley) agreed in the principles on which his conclusions were based theoretically. From a circumstance which was not altogether appreciated at the time, Mr. Leather took away a sample of oil which certainly contained more naphthalene than was usual; and on this sample he had based his theory. At the present time he (Mr. Botley) was working on the same lines as Mr. Leather with the object of confirming or otherwise what he had said. Previously their methods of testing for naphthalene were perhaps defective, or else there was something very peculiar about it which he could not at present explain. Personally he was much indebted to Mr. Leather for the trouble he had taken with regard to the Hastings process; and with the reservation he had made, he accepted his theory as perfectly correct. Mr. Leather said that, in attempting a cure for this evil, one of two things must be aimed at—either perfect deposition by withdrawing the naphthalene or doing something to the gas to cause it to remain in the liquid form. Now the object they had in view at Hastings was, if possible, to retain the naphthalene in the gas; but Mr. Leather came to the conclusion that they abstracted one-fifth of it. This was not of much importance; but if it was a light-giving property it seemed to be desirable to retain as much as possible. If the Hastings process was doing what was suggested—only abstracting one-fifth, which he considered was rather more than really was the case—it was evidently doing as the inventor proposed. Then again Mr. Leather said: "All mists fall if sufficient time be given, and as the spraying apparatus breaks up the oil into particles of varying size, no doubt the larger ones fall first." He (Mr. Botley) did not think that this was strictly correct, because the mist was of a very uniform character, and no gathering of larger drops took place. They had subjected the carburetted gas to a very low temperature without getting any deposit of naphthalene or anything else—showing that by some means (possibly by substitution of some compounds of oil for some compounds previously in the gas), they obtained a result which was not anticipated, but which had the effect of retaining the naphthalene in the gas. He was sorry he had not been able to go into the figures so closely as he should have liked; but the experiments were still in progress. With regard to the process in use at Burnley, he could well understand its successful operation. He did not desire to say much about it just now, as he had to a certain extent a rival method. He would like to point out, however, that, on the basis Mr. Leather laid down, they would require 8000 gallons of creosote at Hastings, which would be rather awkward, while they only needed about 2000 gallons of tea-rose oil, as 1 gallon was sufficient for about 250,000 cubic feet of gas. He also believed that Mr. Leather had, in conjunction with his works, chemical works, which they had not at Hastings. The time was when they would have been only too glad to adopt any plan which would help them out of the serious difficulties they formerly encountered. The stoppages now from all causes at Hastings—such as water, corrosion, and so on—were only 9 or 10 a week; formerly they had as many as 229 in one day.

Mr. THOMAS GLOVER (West Bromwich) congratulated the author on his very clear paper, and thought anyone who had been troubled with naphthalene would be very glad to study it. No doubt, high temperatures, and the use of machinery and other modern appliances, had tended to produce a larger volume of naphthalene; and in the earlier part of the paper Mr. Leather had given his reasons for naphthalene stoppages—pointing out that, owing to it depositing in thin crystalline layers, a great deal of space was occupied in the mains and other distributing pipes until the gas-way was completely closed. Many people had been very much troubled in this way. Two years ago he had the honour of bringing before the Institute a paper which was one of the first to go into the question of the formation and deposit of naphthalene in distributing mains. In the paper, he suggested and described several remedies, which might be adopted—one was: "Modifying the carbonizing and condensing process in such a manner as to avoid the defect." This had been carried out on a practical scale by his brother at St. Helens; and he was glad to confirm what he said, that it had been very successful. His brother's experience was something like Mr. Leather's with regard to the trouble formerly experienced; but now there was very little if any trouble. It was said that high temperatures affected the liquid constituents of carbonization, more particularly the xylene and cumene, which were specially good solvents of naphthalene. These were almost entirely absent in the tar when high temperatures were used. By carbonizing a small quantity of coal at a lower temperature, and introducing the gas at a certain part of the condensing plant, these two solvents were made to dissolve out the portion of naphthalene which would otherwise be troublesome. This was one method of applying the working process which he described in his Institute paper of 1897. The second method described in the same paper consisted of "scrubbing or washing with hydrocarbon fluid the naphthalene-charged gas for the removal of the naphthalene in a similar manner to that by which ammonia is removed from coal gas." The second method was the one Mr. Leather had now tried on a practical scale, and had found to be successful. Mr. Leather had done valuable service in giving the tables contained in the text of his paper; and he (Mr. Glover) might congratulate the author on the relief he had experienced by the use of his washing process—using creosote oil. If he understood aright, Mr. Leather did not use a great quantity of creosote, as suggested by the previous speaker; for the oil was used over again after the separation of the naphthalene—thus bringing down the cost to an extremely low figure. By adding a little benzol to the creosote, the gas could be enriched, or the loss of the illuminating power from the coal gas which would follow by washing with creosote alone could be

* See p. 437 of the number for Feb. 21 last.

avoided. The paper went on to show that the theory which had been put forward in his (the speaker's) 1897 paper was correct—*i.e.*, that solvents of naphthalene must be in the liquid form, and vapours would not act upon it. This had been proved at St. Helens. The sides of the condenser tubes were coated with these solvents; and in this way the naphthalene was removed, while Mr. Leather used creosote oil which washed it out.

Mr. R. G. SHADBOLT (Grantham) said there was one paragraph in the paper which he could not allow to go unchallenged—namely, that "those suggested cures for the naphthalene trouble which consisted of variations of the condensing plant would often be found to be of local value only, and when attempted to be applied elsewhere, different conditions as regards quality of coal, temperature, &c., rendered them inapplicable." These various methods of manipulating the condensing plant which were claimed to assist in the removal of naphthalene had not only done that which Mr. Leather effected in another way; but they also added to the illuminating power of the gas treated. He (Mr. Shadbolt) had been taught that all chemical processes were governed by fixed natural laws; and he had yet to learn that these laws were of local effect only. He believed that they were universal. Of course, if one attempted to apply these various methods elsewhere, there might be different conditions to be taken into consideration; but, once having discovered the means of meeting the varying conditions, the way out of the difficulty was very simple.

Mr. W. W. HUTCHINSON (Barnsley) considered that the gas industry owed a deep debt of gratitude to Mr. Leather for his paper. He did not remember in the history of the Institute one which showed, in such a clear and decisive way, a cure for an evil which had caused very anxious thought to so many members. Naphthalene had been a regular "Will-o'-the-Wisp;" and it seemed to him it had been so owing to the lack of a ready quantitative test for naphthalene in gas. He should therefore like to know if Mr. Leather could give the Institute the particulars of a handy test for determining the quantity of naphthalene in coal gas at various stages, and also how he arrived at the quantity of various substances given in the analysis of Burnley gas—such as benzene, toluene, &c. He (Mr. Hutchinson) might state that at the present time they were rather troubled at the Old Mill works at Barnsley with a deposit of naphthalene; but he thought it arose from the action of the sun on the condensers causing the vapour of the water to get into the gas after a certain proportion of the condensation had been performed, and then the gas having to pass through the inlet of the holder the coldness of the water in the tank caused condensation of the water vapour, and this at once determined the deposition of the naphthalene. This had been so pronounced that a 12-inch pipe (the inlet to the gas holder) had been completely blocked with naphthalene twice within two months. They had two separate works, and he had noticed that at one where the condensers were not subject to the action of the sun there was no trouble of this sort. He was glad to see the statement that 200 gallons of creosote oil was sufficient to take out the whole of the naphthalene likely to cause trouble from 10 million cubic feet of gas. He thought this would strike everyone as being a very cheap way out of the difficulty.

Mr. LEATHER, in reply, said that Mr. Hutchinson had hit on one reason why the naphthalene difficulty had not been more readily solved—namely, the difficulty of estimating the quantity of naphthalene in the gas. Certainly, this ignorance of the quantity was what had kept him from trying his process earlier than he did. When Mr. Irwin first suggested to him that the naphthalene might be washed out of the gas—for he had not noticed the suggestion previously—he put it rather on one side because he thought, as Mr. Botley had said, that they wanted the naphthalene in the gas on account of its enriching value. But the enriching value of naphthalene was not much different from that of benzene; and consequently they could tell pretty fairly what value was obtained from so small a quantity as less than 0·2 lb. in 10,000 cubic feet. It was not worth bothering about, and could hardly be put into figures. He feared there was no very handy quantitative test, such as Mr. Hutchinson desired. The way he estimated it was by passing the gas through a very large excess of benzene, previously carefully freed from naphthalene by repeated distillation, because all commercial benzene contained a certain quantity. It was necessary to pass 200 or 300 cubic feet of gas at a slow rate through a large excess of benzene, and as the benzene evaporated it was necessary to keep adding more benzene. It required something like 2 litres to deal with 200 cubic feet of gas, because a great portion went away with the gas. The gas took up benzene and deposited naphthalene. This was the case with any system of washing or spraying; bringing the gas into contact with any liquid resulted in not only taking something from it but giving something to it. The way of estimating the other constituents was by passing the gas through a heavier oil—such as creosote oil. He had tried different methods, and found the best way to estimate the benzene, toluene, and xylene was by using creosote oil of a high boiling point. By submitting the oil to fractional distillation, and comparing the specific gravities of the different portions of the distillate with the known specific gravity of hydrocarbon of similar boiling point, it was possible to get a fair idea of the nature of the principal constituents which the oil had dissolved from the gas. One advantage of his washing process over the Hastings process was that it dealt with the gas early. People were not troubled much with naphthalene until they took out the ammonia; the reason probably being that in taking out the ammonia they always took out the phenols, which were soluble in water. Until these were taken out, it caused no trouble, as they kept the deposited naphthalene in a liquid condition; and he thought that this had an important bearing on the question where naphthalene should be dealt with. It was certainly preferable to deal with it immediately after taking out the ammonia. With regard to Mr. Hutchinson's question as to why there was a difficulty in one part of the works and not in another, it was a question largely of variation of temperature. With regard to Mr. Shadbolt's remarks on local variations of physical laws, it was undoubtedly quite true that natural laws were universal; but, as most of those present knew, various methods had been suggested for preventing stopped ascension-pipes, and though they acted very well in one works, they would not always act in another. Sometimes the pipes were jacketed with cold water, and sometimes with steam; and both methods had been claimed to be successful. What he (Mr. Leather) meant was that conditions varied; and what acted at one works did not always act at another. He had to thank Mr. Glover for his remarks, and to apologize for not saying that he had suggested this washing with oil before. With regard to Mr. Botley's remarks, he might say that the quantity of creosote used was really only small, if the plant were kept in proper order. They did not need more than 200 gallons of creosote per annum, as it could be used over and over again; and they had been very successful during the last month or two in taking the naphthalene out of the creosote oil. They had no chemical works at Burnley; but they put up a small still for the purpose, which was worked with great ease, and required very little attention. He understood that Mr. Botley was carrying out some further experiments on the lines suggested by himself when objecting to the reliability of previous experiments; and perhaps they would hear something more about it in the future.

Society of Arts Medals.—Among the awards of silver medals by the Council of the Society of Arts for papers read during the past session, we note the following: To Mr. Dixon H. Davies, for his paper on "The Cost of Municipal Enterprise;" to Mr. J. Swinburne, for his paper on "Nernst's Electric Lamp;" and to Mr. Walter Hunter, M.Inst.C.E., for his contribution on the subject of the "London Water Supply."

The Denayrouze System for Wharf Lighting.—Anyone crossing London Bridge or the Tower Bridge at night time last week could hardly fail to notice the unusually brilliant light fixed on the Surrey side of the river about 100 yards west of the latter bridge. The light, which is situated at Stanton's Wharf, was supplied by the Denayrouze Light Syndicate; and it is one of their eight-light clusters, fitted into a specially designed lantern. It is doubtless on account of the very exposed position that so few of the wharves along the river have adopted incandescent lighting; but the experience of the Denayrouze Syndicate is that their high candle-power lights can be fixed in the most exposed positions without any fear of damage to the mantles from the wind. Certainly there is room for an improvement in the wharf lighting along the river; and wharfingers who desire to expedite the unloading of boats arriving after dark will undoubtedly soon recognize the advantages to be derived by following the lead of Stanton's Wharf. It is claimed that this particular light has an illuminating power of 1500 candles, and anyone seeing it will not be prepared to dispute the assertion.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1772.)

THE Stock Exchange has had a very flat week, the aspect of affairs abroad continuing to cause much uneasiness. The Transvaal difficulty was still in a tangle, and superadded to this was the French Ministerial deadlock. This conjunction was sufficient to drag everything down. People as a rule were too timid to do anything, and actual business was extremely limited. Prices all round without exception felt the weight of the position, and gave way. Consols, which opened at 108⅞, fell to 107½ on Thursday, but recovered a little upon better news afterwards from Paris. The Money Market was firmer, with a better demand; and it will be aided this week by the close of the half year. Business in the Gas Market, although somewhat irregular, was more abundant than in the preceding week. Variations in price are neither numerous nor large. They are also pretty well diversified; there being about as many advances in value as reductions. There was no generally ruling tendency; each security being moved by circumstances specially affecting it. Gaslight and Coke issues have naturally attracted the most attention; and by far the greater proportion of the business done was in them. The ordinary opened at 110¾, but dropped the same day to 109; and all the rest of the week it kept fluctuating between 109 and 110—the two closing marks being at these figures. There was a fair amount done in the secured issues; but they did not suffer any reverse. Very moderate business was marked in South Metropolitan, without revealing any tendency towards better prices. Commercials were more active at good medium figures. The Suburban and Provincial Companies were very quiet, but not devoid of interest. Crystal Palace gained a couple of points, marking 138; but British was weak, and fell away a point. Among the Continental Companies, Imperial was fairly active pretty well every day at middle figures; but neither Union nor European attracted any attention. Events in the remoter world comprised advances in Malta and Ottoman, and a reduction in River Plate. The Water Companies were quiet and uneventful; the only changes being an advance in West Middlesex, and a retrogression in Southwark ordinary.

The daily operations were: Business in Gas on Monday was nearly all in Gaslight ordinary, which was weaker, and fell 1. On Tuesday, Gaslight ordinary and debenture had the lion's share, closing without any change; but River Plate declined ¼. Transactions in Gas on Wednesday were very moderate; and prices did not vary. In Water, West Middlesex rose 3; but Southwark ordinary fell 2. On Thursday, there was not much change in Gas—only Ottoman and Malta advancing ¼ each. Friday was quiet, but with a good tendency for the most part. Crystal Palace improved 2; but British dropped 1. Saturday's prices were not very strong; but quotations did not move.

The Accounts of the Automatic Coal-Gas Retort Company.—Touching the proceedings connected with the application of the Automatic Coal-Gas Retort Company for a prolongation of the Coze patent, lest there should be any misunderstanding as to the remarks of Lord Macnaghten and the Solicitor-General upon the unsatisfactory condition of the accounts, it may be explained that the criticism had reference to the improper form in which the accounts were presented for the purposes of the application. The accounts furnished were strictly correct so far as the particulars at command went; and they were drawn up in accordance with the direction of Counsel. Where the Company failed in regard to the accounts was that they hold several patents auxiliary to the Coze patent; and it was impossible for the expenditure and profits to be allocated between them, as required by the Privy Council, so as to show precisely what profit had been made on the patent for which prolongation was desired. Besides, the present Directors cannot be held responsible for the accounts prior to the formation of the Company.

The Management of Engineering Workshops.—The Technical Publishing Company, Limited, of Manchester, have just brought out a little book, under the above title, by Mr. Arthur H. Barker, B.A., B.Sc., &c. It is a collection of articles contributed by the author to the "Practical Engineer;" and as he holds the position of manager of works, he is able to speak from personal experience on the subject he treats. In fact, he tells us in his preface that every item in the system he describes has been tried, modified as experience dictated, and introduced into more than one works. The results have justified him in putting it before other engineers who have the control of workshops. Stated concisely, good works management, he says, consists of two elements—viz., promptly supplying to the shop both the material to work upon and precise and unmistakable instructions as to what is to be done with it; and seeing that the work ordered is properly and quickly done. These are two excellent principles applicable to every productive establishment; and their value will be appreciated by all who have had to give out work. How they have been applied by Mr. Barker will be ascertained from a perusal of his book, which may be conscientiously recommended as containing much sound advice on a matter of the highest importance in connection with manufacturing operations.

ELECTRIC LIGHTING MEMORANDA.

The Board of Trade Report on the Electric Lighting of the City of London—The Case against the City of London Company—A Solution on General Principles—Why the Charing Cross Company were Selected.

THE Board of Trade report on the City of London Electric Lighting has been issued as a parliamentary paper. The preface to this report, signed by Mr. T. H. W. Pelham, an Assistant Secretary, explains clearly how the inquiry came to be held, and gives its net results in a word or two. Applications for Provisional Orders in respect of the City of London were made by the Charing Cross and Strand Company, the Metropolitan Company, and the Smithfield Markets Electric Supply Company. The Corporation of the City of London, as the Local Authority, were unable to consent to any of the three applications, having regard to the contracts existing between the Corporation and the City of London Company. This official statement of the position makes it necessary for us to correct our own description of the state of affairs (see *ante*, p. 1550), which erroneously observed that the Corporation agreed to the admission of the Charing Cross Company. We misunderstood the meaning of the reports of the confused proceedings of the Court of Common Council. The Corporation would not agree with the application of any other Company, but entertained an academic opinion in favour of competition by themselves with the existing Company. The issue came before the Board of Trade in the form of a request for the Board to dispense with the consent of the Local Authority to the applications; and after consideration of Sir Courtenay Boyle's report, "the Board decided to dispense with the consent of the Local Authority in respect of the application of the Charing Cross and Strand Electricity Supply Corporation, Limited, and to grant an Order to that Company." Thus the City of London Company and the Corporation are set aside together, for reasons shown by Sir Courtenay Boyle.

A perusal of this report is instructive, as showing how the Department is disposed to treat the question of competition in this kind of undertaking. The material questions stated by Sir Courtenay Boyle were: (1) Whether, notwithstanding the absence of consent of the Local Authority, any competition with the existing undertakers should be authorized; and (2), if so, to which of the three applicant Companies powers should be granted. The questions had to be answered with regard to the position of the existing undertakers; to the convenience of the consumers; and to the public convenience, with respect to street disturbance. In the first place, the report sets out the statutory history of the City of London Company, which dates from 1890. The financial position and working arrangements of the City Company are briefly stated; and it is recorded that "evidence was tendered to show that the supply given by the Company is inefficient and expensive. Complaints were made as to failures of the supply; and several witnesses urged that a competitive supply would be a public benefit to the City." It does not strike anyone accustomed to inquiries of this kind that this is a particularly strong case for competition, and especially for competition by another Company. There never was a shopkeeper yet, not to say a statutory undertaking, whose business might not be attacked on the same grounds. More to the point is the allegation that the public lighting by the City Company has been defective. A list of fines levied upon the Company on account of these defects is given as an appendix to the report, from which it appears that over the last seven years the deductions have averaged £200 per annum on bills amounting to £13,000 a year. Surely, not a bad showing!

With regard to the failures in private supply, the City Company urged that the worst of these were referable to two occasions—the first, when there was a difficulty in obtaining new plant; and the second, when there was a heavy fog. Furthermore, the City Company pleaded all manner of reasons why they should not be subjected to competition. The chief reason, particular to the case, was that the Company had certain agreements with the Corporation, on the faith of which their capital had been subscribed. On the other hand, Counsel's opinion is cited to the effect that these agreements are null and void. Apart from the question of legality, Sir Courtenay Boyle declined to interpret the agreements as giving the Company any exclusive right of supplying electricity for private purposes within the City. He appears to have taken his own first question as a general one: Is competition in electric supply desirable? Yes, in the abstract. Is competition in the electricity supply of the City of London expedient? The late Sir Francis Marindin inquired exhaustively into this question in 1889, and advised the Board of Trade, as regards the Metropolis, to make it a rule to grant powers to two bodies in respect of the same area. This policy has been confirmed by Parliament. There was only one Company supplying electricity within the City; hence there was room for another. To the final question of who should have the coveted *entrée* into the City preserve, a satisfactory reply was arrived at by the process of exhaustion. The Corporation had no scheme of their own; but they naturally had views on the subject which Sir Courtenay Boyle was disposed to respect. There were three applicants in the field, as already specified, all offering advantages of some kind.

The Smithfield Markets concern is a comparatively small Company, the scope of whose undertaking is indicated by their name. They offered to supply private consumers in the City at 5d. per

unit for lighting, subject to discounts, and 2¾d. per unit for power. The Corporation do not recognize the Company in any way; and Sir Courtenay Boyle did not think them good enough for the place. The Metropolitan Company are good enough; but they are making a large generating station at Willesden for supplying a large Metropolitan district of which the City would constitute only a part. This would present some difficulties in the event of purchase by the Corporation. It was also alleged that the Metropolitan Company are "too thick" with the City Company for the hope of effective competition to be realized. Consequently, the Corporation did not like them; and the Board of Trade respects the prejudice. There remains the Charing Cross Company, whose character is good all round. Besides, this Company are willing to agree with the Corporation upon certain important points—such as keeping the City plant distinct; and consent to purchase within a shorter period than that prescribed by the Acts. For these reasons the Board of Trade have favoured the Charing Cross Company, who will supply at a maximum price of 5d., reduced for large consumption to 4d. per unit, for lighting; and for power at 3d. and 2d. This is the best solution of the problem possible in the circumstances; but it will be bad for the City of London Company. Still, the public interest must come first; and if the City of London Company have a shady past, this is no reason why the people of the City should be taxed for ever on their behalf. It is for the Charing Cross Company to change their name with their new Order; and while they are about it, the name might as well be something short and convenient.

The Petroleum Industry of Roumania.—We noticed some weeks ago the advent of "The Petroleum Industrial and Technical Review," which is being published under the editorship of Mr. Paul Dvorkovitz. In the numbers for the 1st and 15th of April last, interesting articles appeared on "The Petroleum Industry of Roumania," by Mr. D. A. Sutherland, F.I.C., F.C.S. The author has lately returned from the East; and his articles deal briefly with some of the peculiar characteristics of an industry which has within only a few years sprung into great importance. These have been reprinted in pamphlet form, with reproductions of photographs of the locality concerned, and accompanied by a geological map showing the petroleum fields and intersecting railways.

"The Housewife's Manual of Domestic Cookery."—Under this title, Messrs. Fletcher, Russell, and Co. have published a collection of 770 recipes for the preparation of "dainty and simple dishes for the year round, in health and sickness." They have been collected with special reference to cooking by gas, and are edited by Mrs. H. M. Young, whose name will be familiar to our readers in connection with her demonstrations of the value of gas for culinary purposes. Mrs. Young has taken the recipes from her earlier books on "Choice" and "Domestic" cookery, carefully revised them—adding much new matter, partly original—and arranged them in the order usually followed at a dinner, excepting that breakfast dishes, savouries, &c., follow the fish. The titles are given in English and French; so that a *menu* can be produced in either language. The book is illustrated by a number of beautiful reproductions of photographs of dishes as actually prepared or in progress. There is a chapter on "Invalid Cookery," and another on "Food in Season." Finally, some excellent advice is given on the management of a gas cooking-range. Reference to the recipes is facilitated by an index.

The Industrial Position of Germany.—Much has been said of late about this, especially in the departments of chemistry and electrical engineering. It may be some consolation to the British manufacturer and trader who have been so passionately adjured to copy German methods, for the public to be reminded that there is another side to the picture of German industrial expansiveness. It is believed in financial circles that some check will have to be imposed upon the present excessive rate of German industrial developments. The growth of production is regarded as outrunning the strength of the country; and for the present, at any rate, the best thing that could happen to Germany would be a period of quiescence, if not of retrogression. An example is found in the recent extraordinary increase of electrical manufacturing undertakings, fascinating accounts of which have filled the English engineering periodicals for some time past. The capabilities of these establishments are altogether disproportioned to the needs of the country, and their products cannot find a market abroad at remunerative prices. In short, over-production, especially of electrical wares, is the pressing danger of Germany for the present year; and this means ruinous competition at home and abroad. Up to the present time, the cheapness of German manufactured goods has largely depended on the contentment of the working population with a lower standard of remuneration than has prevailed in other industrial communities. This state of industrial experience is fast passing away; and in the estimation of those best qualified to judge, German employers will have to pay higher wages in future to the workpeople who are able to make the articles that sell all the world over. It remains to be seen how the much lauded German technical education, so highly appreciated by the President of the Institution of Gas Engineers, will stand the strain of the altered labour conditions of the present day

OLD-AGE PENSIONS.

The Influence of State-Aid on Character.

In these days when, we are told, "we are all Socialists," and when the question debated is generally how (rather than whether) pensions are to be provided for the aged out of the Imperial Exchequer, it is interesting to find a writer boldly disputing the wisdom of such a policy, and asserting that any such scheme would tend to the enervation and deterioration of the labouring classes whom it is designed to benefit. Such, however, is the conclusion drawn by the author of an article in the "Quarterly Review" (entitled "The Wages and Savings of Working-Men") from a consideration of the causes and the extent of the improvement in the position and character of the industrial classes during the past seventy years or so; in the writer's words—from a study of "the gradual transference of a population from a condition of *status* to one of contract. *Status*, in its fullest conception, involves the customary or forced labour of the serf, and his exclusion from the benefit and responsibility of private ownership. . . 'Contract,' on the other hand, implies that every man has a right of ownership in his own labour, in the fruits of his own labour, and a right of exchange."

The author proceeds to demonstrate in his article the general advantages which have accrued to the working-classes by their transference from the one condition of labour to the other; and he bases his condemnation of any proposal to provide State-aid for the aged or disabled, upon a comparison of the idle, thriftless, incompetent labourers who existed under, and were produced by, the statute which, prior to the reformed Poor Law of 1834, gave every man, however able-bodied, the right to maintenance out of the poor rate, with the free labourers of to-day, who are, taken as a body, men of entirely opposite character and of vastly more productive value to the community. Upon this comparison, also, the writer founds his theory that the possession of property—either in the form of ownership of his own labour or, especially, in the form of actual savings resulting from his labour—is slowly but surely elevating the character and modifying the conduct of the average working-man. It may be observed that a study of the industrial history of our country during the present century is an excellent corrective for an exaggerated discontent with existing conditions and a pessimistic view of the future—though the politic man will not use the fact that the present state of affairs compares favourably with the past as an argument against striving for a better condition of things in the future.

Not the least interesting section of the paper is that which illustrates the great increase in the remuneration of labour during the past half-century, both in the actual money earned and in the enhanced purchasing capacity of wages through the cheapening of commodities. These larger earnings, by increasing the purchasing power of our own industrial population, have diverted some of our commercial enterprise from the foreign to the expanding home markets. "In other words, our own artizans are better customers than the poorer industrial classes of other nations;" and it is suggested that this fact is an explanation of "a paradox we all instinctively know must be untrue"—namely that the correspondents of the Foreign Office possess knowledge, as to the best way of managing our foreign trade, superior to that of the British trader himself. We are far from endorsing the suggestion that our merchants have little or nothing to learn from the Consular Reports; but it may usefully be borne in mind that the loss or abandonment of a foreign market may only mean that our hands are fully and more profitably occupied in supplying home demands.

The writer, then, contends that the adoption of "Old-Age Pensions" would be a step backward, undoing practically speaking all the good accruing from the habits of self-help and providence engendered in the working-classes by their emancipation from the degrading system of indiscriminate rate-aid. In this connection, reference is made to Mr. Booth's scheme for a universal pension of 5s. to every person over the age of sixty-five; and it is asked—and the question is not easily answered—why a distinction is drawn between State provision for the old, and State provision for the sick, the widow, and the orphan. No mention, however, is made of those schemes for old-age pensions which, so far from making total incapacity for self-support the title-deed to a State allowance, would make evidence of thrift the condition precedent to State help. Such schemes, though little calculated to reach the really hard, pathetic cases of destitute but honourable old-age, are certainly not open to the charge of tending to discourage providence.

The more anyone examines the question of providing some alternative to starvation less pauperizing and hateful than the workhouse for such deserving cases, the more difficult it is seen to be; and, as an attempt to indicate the harm which might be done by the adoption of well-meaning but ill-advised schemes of indiscriminate State-aid, the article deserves the attention and consideration of all interested in the subject. Having in view the growing tendency among employers to refuse employment to those past middle-age, we cannot but express the hope that such employers may be numbered among the most eager to find a solution of the difficult problem. The writer evidently and justifiably looks to the Friendly Societies for much help in reaching such a solution; not only directly, although they are

doing much in that way, but also by reason of their being powerful influences in the spreading of the principles of foresight and economy, and in engendering a spirit of self-respect and independence in the working classes. Evidence is adduced in support of the opinion "that there is no class in this country that is debarred from attaining the absolute independence of poor-law relief which, with very few exceptions, is enjoyed by the members of Friendly Societies."

Some interesting statistics, mainly gathered from Mr. E. W. Brabrook's volume on "Provident Societies" (which has already received notice in these columns), are given as to the growth and wealth of the Friendly, Benefit and Co-operative Societies. In connection with the latter Mr. Livesey's profit-sharing scheme is instanced as a strikingly successful plan whereby a sullen and mutinous army may be converted into a contented and cheerfully industrious body of co-operators, with obvious advantage to all concerned. The combination of capital-owning with profit-sharing in the South Metropolitan scheme is mentioned as being a factor on which a good deal of its success appears to depend; and it is, therefore, regarded by the writer as a proof of his theory that the possession of property by the working-classes tends to raise the character and stimulate the industry of that section of the community, and thereby to advance the well-being of the whole.

HINTS ON MASONRY.

UNDERLYING all the talk about engineering novelties, which is so interesting for the moment, there is a mass of science of immemorial origin which very rarely forms the subject of "papers." Yet it is in possessing an adequate knowledge of these fundamentals that professional competence consists. One is reminded of the importance of these elemental parts of engineering science on reading, in the "Engineering Record," an abstract of a most valuable paper by Mr. George S. Morison, a Past-President of the American Society of Civil Engineers, on the subject of "Masonry." For whatever else a constructing engineer may know, he is bound to know all that is worth knowing about the whole body of science comprehended in this one word. A true engineer will always be known by the degree of interest he takes in bricks and mortar, together with concrete, stonework, puddle, and everything else of the kind. Thus it was easily observable how at the last meeting of the Institution of Gas Engineers, the members sniffed out the interesting questions raised by the President's declaration in favour of the use of moulded blocks in retort-setting in lieu of bricks. The circumstance is characteristic of English—and we may add of American—civil engineering, as distinguished from the scholastic engineering of European countries. Only begin to talk sensibly about masonry, and so forth, amidst a company of English or American engineers, and an interested audience will be created on the instant. On all hands, it will be felt quite refreshing to get, once in a way, down to the essentials of all construction work.

Mr. Morison had a good deal to say about masonry that was well worth putting upon record. On the subject of brickwork it was laid down that the harder and less absorbent the bricks, the better and more durable they will prove, although their burning should not be carried to such an extent as to make a smooth, vitrified surface to which mortar will not adhere. It may be remarked, in parenthesis, that probably the familiar Staffordshire blue brick is the best brick the world ever saw. The much vaunted ancient Roman brick was really a tile. In brickwork the joints form so large a proportion of the mass that the strength of a brick wall is determined by that of the mortar. In a perfect wall, the brick and the mortar would be of equal strength. The development of brickwork can be followed plainly from the most ancient Roman work, which was really concrete with tile bonding, to modern pressed-brick walling and fire-brick work, in which the joints are as thin as possible, having regard to the necessity of perfect bedding. A good concrete should be absolutely solid; there should be enough cement in the mortar to fill all the voids between the grains of sand, and enough mortar in the mass to fill all the voids between the stones—this is the ideal, which is seldom attained in quick, hurried work.

Mortar, says Mr. Morison, acts by distributing the load over, and increasing the friction between, the stones or bricks composing the wall. A lime mortar does not set; it merely hardens slowly. The latter is a chemical reaction between the lime and the other elements; and the best results are obtained by mixing the mortar some weeks before it is used, and not subjecting it to any great strain until a considerable time after it is laid. The action of cement is totally different; the cement itself containing all that is necessary to setting and subsequent hardening. Sand in cement is a diluent; in lime mortar it is an essential. It is permissible to vary the cohesive strength of cement mortar by altering the proportion of sand; but lime mortar must be always good alike. By way of emphasizing this teaching, Mr. Morison makes the almost paradoxical admission that if poor lime mortar is to be permitted at all, it must only be with the very best of cut stone work, because the closer the work, the nicer the fitting and the more perfect the shape of the stones, the greater is the work done by friction and bonding, and the lower the duty that falls upon the mortar.

In both lime and cement mortar, including concrete, the best results are due to work—the work of mixing. The more complete the incorporation of the ingredients, the better the mortar will be. In mixing lime mortar, time need not be considered. Thus the excellent Indian mortar, made of "Kunker" lime and brick dust, becomes as hard as portland cement; this result being due to the amount of working it receives. "The secret of good mortar is work." Where cement is used, the working has to be done expeditiously. Mr. Morison is not satisfied with the comparatively little use made of mortar-mixing machines. He does not discuss the use of mortar-mills, so general in good English masonry work.

One of the most proper uses of masonry is for retaining walls, which in various forms are so common in gas-works construction. A retaining wall fulfils the double office of bearing its own and any superincumbent weight, and of keeping back the mass of earth or other material behind it. The resultant of the horizontal and vertical strains is a curve more or less inclined to the perpendicular. To produce the best results, the masonry should be laid up in inclined courses, with joints everywhere normal to this resultant curve. The wall must be so proportioned that the resultant curve shall never pass outside of the middle third, which means that the weight of the masonry acting downward must be greatly in excess of the horizontal thrust of the backing. Hence the main duty of a retaining wall is to provide weight; and a large quantity of cheap masonry may be better for the purpose than a smaller amount of first-class masonry.

There is no class of structure, Mr. Morison admits, in which the determination of the strains is more uncertain than in a retaining wall. The principal difficulty lies in the uncertainty of the thrust of an earth bank, which varies with the degree of saturation, with the method of its formation, and by irregularities of both time and place. Consequently, it is perhaps as safe to follow arbitrary rules as to make close calculations. A common rule is to make the thickness of a retaining wall for ordinary earth never less than 40 per cent. of its height above the measured thickness. In exceptionally favourable circumstances, this may be reduced to 30 per cent. of the height; but where there is any vibration or liability to other disturbances, the thickness should be increased to 50 per cent. of the height. It is also to be remembered that nearly all foundations are compressible; and that the pressure on the foundations of a retaining wall may increase from nothing at the back to twice the average at the face, which means that a retaining wall on a yielding foundation will move forward to an amount which can seldom be estimated, but must generally be provided for.

Another proper employment for masonry is in the arch. Most engineering students are greatly exercised as to the rules applying to the stability and strength of masonry arches. Beginning with the full-centred, or semicircular arch—commonly used, by the way, in covering gas retort-settings, where the greatest strain is due to intense heat acting against the intrados—Mr. Morison remarks that this form requires very careful treatment. If the filling above the arch is carried up solid, the weight distributed over it does not correspond to the form of the arch, and rupture is likely to occur at the haunches. This is obviated by using a hollow filling over the haunches, either by cellular construction or by building up the spandrels with cross walls carrying small arches. A favourite form, and the best in many respects, is the segmental arch—preferably one with a rise of about one-quarter the span. With these proportions, there is less difficulty in conforming the load exactly to the curve of the arch. Mr. Morison lays stress upon the fact that the essential characteristic of an arch lies in its acting only in compression in resisting strains, produced by weights, which follow the curve. Thus a thrust at each end is implied. This thrust must be taken by tension-rods, or preferably by the weight of masonry. These features are inseparable from the true idea of the arch. People who are influenced by the vagaries of amateur art talk, imagine they see the origin of the arch in the meeting boughs of overhanging trees, or in the bent sapling with which the savage constructs his rude hut. This fanciful idea is dismissed by Mr. Morison as absurd. The first arch was built when two inclined stones were first balanced against each other over a wall opening. Mr. Morison observes, very keenly, that the sense of strength and repose produced by a sound arch construction is conveyed when the abutments are sufficiently stout, not only to resist the strain, not only to bring the resultants within the middle third, but to give such a superfluity of material that the idea of effort never occurs to the observer.

A dome is essentially different from an arch, with which it seems to have so much affinity that some superficial reasoners have derived the one from the other. The radical difference is that an arch is only self-supporting when it is complete. It must be supported by some external means until the keystone is placed. A dome has no keystone, and its central portion may be omitted without impairing its stability. Every ring of a dome is self-supporting, as soon as completed, because it cannot fall inward without diminishing its diameter. The dome, however, like the arch, exerts an outward thrust at its base, or springing. Most domes are kept from spreading outward by a curb, or metallic band. A masonry dome of uniform thickness is always stable when the height does not exceed one-quarter of the span; but such a dome would at once become unstable if loaded with a heavy lantern. Mr. Morison notes the significant fact that low domes of this proportion are

"almost always pleasing to the eye." This remark recalls the fact that the domes of gasholders, which are not popularly endowed with this quality of sightliness, are not usually half as high. It may be asked whether the huge gasholders which are almost the only domed structures of large size now met with, would be more sightly if their tops were formed into more lofty domes. Perhaps not; but the point brought out by Mr. Morison, regarding the pleasing appearance of moderately high domes, is worth bearing in mind. Altogether apart from considerations of appearance, gasholders some years ago were usually made with very little rise of crown. There was no advantage in this form, however; and the practice has altered.

One of the most useful suggestions of Mr. Morison's paper is that domes might be more generally used to roof important buildings. If constructed of light concrete—say, coke breeze and cement—very thin, with a series of parallel steel rings imbedded in it, a dome roof would be self-sustaining throughout, in every sense. The admirable lighting and facilities for efficient ventilation provided by this form of roof are not its smallest recommendation. This fact was well known to the ancients; and the Pantheon in Rome—the oldest, and in many respects finest, domed building in existence—exists to show these advantages of the form. It is probable that a study of the domed style of roofing for some large industrial buildings, including gas retort-houses and railway stations, might help constructors to a means of escape from the deadly ugliness of such structures, without necessarily sacrificing the paramount claims of economy and fitness. It is at least certain that a freer use of domes in modern town buildings would do much to relieve the painful uniformity of the sky-lines of streets and open places. Taken in conjunction with the growing demand for fire-proof construction in respect to the same order of buildings, it is open to be argued that Mr. Morison's timely reminder as to the capabilities of the dome, and his suggestion of a method of making cheap and strong domed roofs, constitute an important contribution towards the solution of a grave problem of the day.

SULPHATE OF AMMONIA AS MANURE.

One of the facts which seems to be generally demonstrated by the experimental work of the Agricultural Committees of the various County Councils is that sulphate of ammonia is the best manure for certain purposes; and to the testimony of this kind already published may now be added that adduced by the Cornwall and the Wilts Committees. That of the Cornwall Committee is particularly candid and instructive. Previous experiments had shown that, in the growing of mangel wurzels, the use of 2 cwt. of nitrate of soda left a large profit; but the profit was more than doubled when 4 cwt. per acre was applied. Nevertheless the results pointed to the conclusion that, at certain stages in the growth of the crop, sulphate of ammonia is the more profitable form in which nitrogen can be applied for mangels. It is true that it produced only a slightly heavier crop than nitrate of soda when drilled with the seed. But still sulphate had the best of it; and seeing that this harmonizes with scientific teaching, additional plots were last year laid down with sulphate of ammonia. The results afford tolerably conclusive proof of the superiority of sulphate as a drilled manure for mangels. With 3 cwt. per acre of superphosphate, *plus* cross-dressing, *plus* 2 cwt. of sulphate of ammonia, a yield of 42 tons 8 cwt. resulted; while the same proportions only with the substitution of nitrate of soda for sulphate yielded 40 tons 3 cwt. 1 qr. In the previous year (a bad one for roots), the figures were 37 tons 10 cwt. 2 qrs. from sulphate and 36 tons 3 cwt. from nitrate. These figures, the Committee say, should be better understood. Great stress has been laid on the fact that nitrate of soda is a valuable manure for this crop; and its value is due in no small degree to its highly soluble character. Nevertheless, when drilled with the mangel seed, this solubility is often a decided disadvantage, as the manure may in consequence be washed quite out of reach of the plants before they are in need of applied fertilizers. But with sulphate of ammonia the case is entirely different; for it is not easily washed out of the land while the plant is passing through the earlier stages of growth, as it is then undergoing chemical changes and steadily passing into a more available form. It is as nitrates that plants take up almost the whole of their nitrogen; and until the nitrogen of the sulphate of ammonia has assumed this form, it is not an available plant food. Viewed in this light, it will be seen that sulphate of ammonia may be expected to give better results as a drilled manure for mangels than nitrate of soda.

By way of further experiment the Committee last year added Kainit to sulphate of ammonia and superphosphate, to make up a drilled manure for mangels. The plots receiving this manure produced the heaviest crop grown in any single plot, a heavier average crop than was produced by any other drilled manure, and a heavier crop than was raised by any other drilled manure when cross-dressings were added. These, the Committee remark, are significant facts. The heaviest crop—65 tons 2 cwt. 3 qrs. per acre—was grown with 3 cwt. of superphosphates per acre, 2 cwt. of sulphate of ammonia, 4 cwt. of nitrate of soda, and 2 cwt. of Kainit. As drilled manure, 3 cwt. of superphosphate and 2 cwt. of sulphate of ammonia gave a crop of 39 tons, 3 cwt. 1 qr. per acre, or a profit (after deducting the cost of the manure) of £3 5s. 10d. per acre. The addition of 2 cwt. of Kainit increased the yield to 40 tons 10 cwt. 3 qrs.; and the profit to £3 13s. 7d. Cross-dressing of the plots in which superphosphate and sulphate of ammonia were used in the above proportions as drilled manure, increased the yield to 42 tons 8 cwt., representing a profit of £4 1s. 11d.; while cross-dressing of the plots in which superphosphate, sulphate of ammonia, and Kainit were employed gave a crop of 43 tons 15 cwt. per acre, or a profit of £4 8s. 6d. The most successful combination was, however, as follows: 3 cwt. of superphosphate, 2 cwt. of sulphate of ammonia, 2 cwt. of Kainit, and 4 cwt. of nitrate of soda. This produced, on an average of all the plots on which it was tried, a crop of 49 tons 10 cwt. 3 qrs., or 19 tons 18 cwt. 3 qrs., in excess of the produce of unmanured land. The cost of the manure was £3 11s. 9d. per acre; and the net profit from its use, £6 7s. 4d.

The report deals with experiments with other manures; but the conclusion of the whole matter, based on 991 experiments during the last two seasons, is that the following mangel manure leaves a profit of over £7 per acre: 2 cwt. of sulphate of ammonia, 3 cwt. to 6 cwt. of superphosphate, and 2 cwt. of Kainit drilled with the seed; or 4 cwt. of nitrate of soda, 4 cwt. of salt, and 2 cwt. of Kainit scattered broadcast.

In the Wiltshire experiments the sulphate of ammonia was employed as a manure for potatoes. Used in the proportion of 4½ cwt. together with 8 tons of stable manure per acre, it gave a heavier crop than any other manure used. The yield was at the rate of 12 tons 13 cwt. 90 lbs. per acre; being 4 tons 18 cwt. 23 lbs. in excess of that from the unmanured plot. The value of the excess is put at £11 9s. 2d.; and the cost of the manure at £4. This shows a net gain of £7 9s. 2d. per acre from the use of these manures.

PERSONAL.

Mr. William G. Quicke, of Cardiff, has been appointed Assistant to Mr. C. Stafford Ellery, Engineer of the Bath Gas Company.

We are pleased to learn that Miss Lapthorn, who came out Senior Lady Wrangler at the recent Tripos Examination at Cambridge, is the daughter of Mr. E. Lapthorn, J.P., the Chairman of the Gosport Water Company, and a Director of the Gosport Gas Company.

Owing to ill-health, Mr. R. Ashton has resigned the Secretaryship of the Barnstaple Gas Company, which he has filled for 35 years. He still retains the position of Manager, and is succeeded as Secretary by Mr. F. L. Schofield, who has for many years been with Messrs. Alfred Lass, Wood, and Co.

Mr. J. H. Pye has returned to England, after completing his engagement as Manager of the Barbadoes Gas Company; and before leaving the Colony was the recipient of a gratifying presentation from the workmen in the shape of a handsome travelling clock. Mr. M'Elroy, of Montreal, succeeds Mr. Pye as Manager at Barbadoes.

Alderman Andrews, who has been Chairman of the Coventry Corporation Gas Committee since the works were purchased by the Corporation in 1884, last Wednesday announced his resignation of the position owing to what he considers the illegal action and want of confidence shown by the Council in appointing the Principal of the Technical Institute as gas tester.

In connection with the account of the progress of the Oldham Corporation gas undertaking during the past fifty years which appears in another column, it is interesting to note that the two principal officials—Mr. John Chadwick, the Manager, and Mr. Arthur Andrew, the General Superintendent—have been associated with it practically all their lives. Mr. Andrew is also Superintendent of the Water Department; Mr. G. H. Hill being the Consulting Engineer.

We regret to record a serious accident which happened to Mr. John Tindall, Manager of the Walsall Corporation Gas-Works, on the evening of the 17th inst. He was walking along one of the busy thoroughfares of the town between seven and eight o'clock, when he received a severe blow on the head which knocked him down. The cause was the breakage of a tramway trolley wire, one of the ends of which dropped across Mr. Tindall's hat, which by good chance was made of stout block felt, and so considerably reduced the force of the blow, and saved him from an electric shock. Mr. Tindall was driven to a doctor's, and thence to his home. Subsequently Mr. W. Gorse, who has recently been appointed Assistant-Manager, and who is an electrician, inspected the wire, which had previously broken at the same place and been repaired. Fortunately, Mr. Tindall was not injured beyond the shock to the nervous system, which he feels probably more acutely from the fact that his health lately has not been good. The result of a medical consultation on Wednesday was his departure the following morning for Rhyl, for a month's rest and change. All his professional colleagues and friends will, we are sure, unite in expressing the hope that he will on his return resume with renewed vigour the control of the undertaking with which he has been associated for nearly thirty years. In the meantime, it is in the hands of Mr. Gorse. This is, unhappily, the second accident to Mr. Tindall which we have had to record. It may be remembered that when the Midland Association of Gas Managers visited the Cheltenham Gas-Works five years ago, he stepped upon a retort-lid, and fell to the ground, dislocating his right shoulder.

NOTES.

The Position of Mechanical Road Traction.

The most interesting event of the summer for mechanical engineers was the "automobile" exhibition just concluded at Richmond. For the first time, a large number of mechanically-driven road carriages were collected in a place and under conditions that permitted adequate display of their running powers on ordinary roads and over a cinder path. The exhibition afforded a complete indication of the progress made in this new combination of mechanical engineering with carriage-building. A survey of the exhibits in the sheds and on the road created several strong impressions. One is that good advantage has already been secured for users of heavy road vehicles, in the Thorneycrofts, Lifu, and Leyland steam waggons or lurries. For the haulage of gas coals, where this has to be done over common roads the merits of these vans, in which steam is raised by liquid fuel, deserve consideration. The first cost of such waggons is high; but the running expenses are low. For smaller carts and carriages, the choice lies between accumulators and mineral oil as the source of power. Compressed coal or oil gas is abandoned. For silence, gentleness, and steadiness, electric driving bears the palm; but unfortunately these benefits are set off by the dependence of the motor on the generating station, to say nothing of the working cost. Most of the self-contained carriages at Richmond were of French or German make. They were driven by petroleum spirit or oil-gas engines; and were noisy, shaky, evil-smelling machines. A good deal of patient, clever work will have to be done upon the details of these vehicles before they can be styled satisfactory according to an English standard.

The Effect of Strain Upon Metals.

The precise manner in which metals fail under excessive strain has been observed at the Cambridge engineering laboratory by Professor Ewing and Mr. Rosenhain. The microscopic examination of polished metallic surfaces, when lightly etched, has been pursued by Andrews and others, and has shown that all metals are made up of irregularly-shaped grains with well-defined bounding surfaces. The exposed face of each grain consists of a multitude of crystal facets, with a definite orientation. The grains are, in fact, crystals. By observing the surface showing these crystals, while actually being subjected to tension sufficient to ultimately break the specimen across, the observers were able to detect the cause of failure. When the strain surpassed the elastic limit, a number of sharp black lines began to appear on the faces of the crystalline grains. On each grain the lines were more or less parallel; but their direction varied in contiguous grains. The appearance of the grains was so like that of a crevassed glacier, that the dark lines might readily have been taken for cracks. These are not cracks, however, but slips along planes of cleavages which do not amount to positive solutions of continuity. The slip-bands are developed by compression as well as by extension. Microscopic examination does not reveal any difference between the results of the two methods of strain. It is because the metal is an aggregate of irregular crystals that it is plastic as a whole, and is able to be deformed in any manner as a result of the slips occurring in individual crystals. Plasticity requires that each portion should be able to change its shape and position. Each crystalline grain changes its shape through slips occurring within itself, and its position through slips occurring in other grains.

Sewer Ventilation by Diffusion.

Sir Charles Cameron has described, before the Royal Institute of Architects of Ireland, a method of ventilating sewers which he prefers to the usual street openings or shafts, even when the action of the latter is accelerated by a flame of gas. Upon the general question of sewer ventilation, the necessity of which is usually based upon the hypothetical risk of the sewer gases attaining sufficient pressure to force the traps of house drains connected with the sewer, Sir C. Cameron is frankly sceptical. He has made many experiments to ascertain whether gas pressure exists in sewers, and has never been able to determine the fact, beyond the most trifling amount, when all the ventilators on considerable lengths of sewer mains were closed. Moreover, he doubts whether the emanations from ordinary sewage are so abundant and dangerous as to imperil the life or health of the men working in the sewers. Men have been suffocated in sewers; but death has been caused in this way "not by ordinary sewage air, but by sulphuretted hydrogen set free from refuse from gas-works, or from waste gases from gas-engines allowed improperly to get into sewers, or from other exceptional causes." It is for this reason that well-instructed sanitary authorities have the greatest objection to the discharge into sewers of water that has been in contact with illuminating gas. Notwithstanding the example of Bristol, where the sewers are not ventilated at all, Sir C. Cameron is in favour of this ventilation, though not by the means now generally employed. He has suggested a means which the City Engineer of Dublin, Mr. S. Harty, has approved of and uses in certain circumstances. This method of ventilation depends upon the principle of the diffusion of gases through porous materials. Messrs. Doulton manufacture the necessary apparatus, which is in the form of cylinders inserted in the crown of the sewer. These porous earthenware cylinders permit of the passage of the air but effectually bar the passage of microbes.

TECHNICAL RECORD.

SOCIÉTÉ TECHNIQUE DU GAZ EN FRANCE.

Annual Meeting in Paris.

The Twenty-sixth Annual Meeting of the above-named Society was held on Tuesday last and two following days, in the Salle Charras, Paris. M. Vautier was in the chair; it being his second year of office. The pleasing hall in the Rue Charras was well filled with members, of whom nearly 250 were present, though its ventilating and acoustic arrangements left something to be desired. The first business of the meeting was the admission of new members, to add to the 623 then existing. The President of the Gas Institute was elected, according to custom, as an honorary member; and the names of 34 members and 5 associates were added to the roll—thus making the total membership very nearly the same as that of the English society. The report of the Committee was read, and reference made to the losses by death during the past year. Among other names of deceased were those of M. Emile Coze, M. Melon, the President of the Society for the session of 1892, and M. Niel, who had studied in England and America, and had invented a gas-engine known by his name. The Treasurer's report was increasingly satisfactory, and showed a surplus of income over expenses of 9066 frs., or about £360. The election of members to serve on the Committee for the ensuing three years resulted as follows: MM. Godinet, Bigeard, Thibaudet, Gardiner, and Bouvier. This concluded the morning's business.

Reassembling in the afternoon, with a lack of punctuality that was hardly commendable, the President read his address. It was confined to a review of the various standards of photometry adopted in different countries, chiefly England, France, and Germany. As the English methods were more dwelt on than others—confirming the recent remark of Mr. Samuel Stewart, in his Inaugural Address to the Gas Institute, that "very close attention appears to be paid to what is done on this side of the Channel"—there is not much to be said of fresh interest to our readers. The address was illustrated by actual exhibits of apparatus and by lantern slides. It must be confessed that the latter were somewhat reminiscent of the familiar plates of English photometer makers' catalogues. Then followed a description of German methods; and afterwards a detailed account of the pentane argand burner with carburetter, and of the acetylene standard of M. Violle, introduced in 1895.* The address, although very useful in focussing the variations in principle and in practice found in the photometry of different countries, was rather more on the theoretical and scientific side of gas testing than on the broad and practical one of daily experience. This, after all, was only natural, in view of the eminent qualifications of M. Vautier as a professor of science rather than as a gas engineer. The difference often found between an English and French presidential address was also emphasized. The former generally touches on many topics, and constitutes a personal review of gas matters; while the latter is frequently confined to only one subject, which is treated exhaustively, but sometimes, we are afraid, too theoretically. M. Vautier was heartily applauded on concluding his address.

Separating the President's speech from the reading and discussion of the papers presented, and destroying the usual sequence in programmes of this kind, was the presentation of awards. A prize of 500 frs. was given to M. Gailliard, Superintendent of the gas-works at St. Fons, Rhône, for his paper on "The Origin of Carbonic Acid contained in Illuminating Gas, and its Influence on the Lighting Power." This was the subject set by the Society for their competitive essays. The Committee have deemed it advisable to withhold for some weeks the successful paper from publication, owing to an apparent contradiction contained in it. MM. Teissier and Nègre received an award of 300 frs. for having made a notable improvement in gas plant by the introduction of the fluted or undulating retort. It was reported that the trials carried out with this retort by the South Metropolitan Gas Company and others had proved satisfactory. Prizes of 250 frs. each were given to MM. Bachelay, Bouvier, and Desmazes for their respective papers at last year's meeting; and 47 donations of 200 frs. each were made to foremen and workmen having the longest and best records of service. All the recipients of these honours were duly congratulated. A great deal of time was taken up by the presentation of these gifts; but at last the way was clear for the more important business of the reading of papers.

There were no fewer than 26 technical communications—some of but three pages, others of ten, and two of no less than 53. Only four papers dealt with important constructional matters; six were descriptive of burners and their accessories; and the remainder referred to different details of work or of management, and to items of either chemical or theoretical interest. It may here be said that the manner of conducting both the reading and the discussion of the papers was not altogether as it should have been. Even in the meetings of our own associations at home there is oftentimes a considerable lack of the formality necessary for an adequate and pointed discussion. At the French meeting this was also the case. On some of the papers there was

* See "JOURNAL," Vol. LXVII., p. 334.

practically no discussion, while on others it sometimes degenerated into nothing more than an informal conversation between the two members interested, and was inaudible to the majority. Of course, there were exceptions to this; one being the discussion on the first paper read to the meeting. The author of this was Mr. Brackenbury, of London, who described the hydraulic stoking machines of Sir William Arrol and Mr. Foulis. The subject is, of course, one of more interest in France than in England, where the machines are well known to all, while in France, as far as our knowledge goes, there is not as yet a single installation of any power machinery for the charging and drawing of retorts. M. Coze opened the discussion; remarking that, from the figures given in the paper, it would seem that the amount of coal carbonized per man and per shift with the machines was only about 2100 kilos (2 tons), whereas with inclined retorts—naturally a very favourite subject with the speaker—a much larger amount could be obtained. M. de Savignac, Secretary of the Union des Gaz Company in Paris, took up the discussion, which became somewhat animated, and confirmed the results given in the paper. M. Godinet, of Lyons, spoke of the eight pairs of similar machines which he had seen at Vienna; and M. Krafft, of Naples, also made an interesting speech. The point raised by the first speaker was not of much importance, as the cost per ton of coal carbonized was of far greater consequence than the amount carbonized per man. The author of the paper had also avoided any comparison between horizontal retorts with machinery and settings of inclined retorts, wishing to confine himself to the subject-matter of Arrol-Foulis stoking machinery. This finished the first day's business, and the meeting was adjourned.

On the following days, other papers were read and more or less discussed. M. Daudy (Angers) expressed the formation of stoppages in ascension-pipes in terms of mathematical formulæ—no doubt an occupation of some interest, but hardly, one would think, of practical value. The method of scurfing retorts followed by the Compagnie Française du Centre et du Midi, was described by M. Brouardel. A pipe of 200 to 250 mm. (8 to 10 inches) diameter is placed in front of the retort-bench, with arrangements for making connections for any retort. When a retort requires scurfing, a bend which goes into the retort a distance of 1·5 metres (about 5 feet) is connected to the fixed main, and by means of a blower, working at 2000 revolutions, the retort is cleaned of its carbon in about 30 minutes. There is, of course, nothing of novelty in this.

M. Bouvier read an interesting paper on an installation of aërial way for the transport of coals, which was put up at the Metz Gas-Works in 1893. The author cited examples of different methods of transport: (1) Horizontally, with belt or endless screw conveyors, or suspended ways; (2) vertically, by lifts or cranes, driven by gas as at Paris (Clichy) and Nantes, or by electricity as at Havre; and (3) horizontally and vertically combined, as at Metz, or by the Temporley system. At Metz the railway waggons discharge their coal into a V-shaped tank of 20 tons capacity, from which the waggons on the aërial way get their supply. The coal is carried a distance of 64 metres (70 yards) to the stores; the gradient being 1 in 6·4. The cost of taking the coal to the stores has been reduced from 1·08 frs. to 0·74 fr. per ton. M. Bouvier also prepared a second paper suggesting the more general use for gas-works of graphic representations and diagrams, and the advisability of supplementing the usual plans of works with one on the vertical line, showing the height of the retort-benches and other appliances, and the entire course of the gas. A practical example of such a vertical plan was given, illustrating the Geneva Gas-Works in 1892. M. Des Gouttes gave an account of recent extensions at the same works, in connection with an installation of inclined retorts. There are the usual conveyors and elevators—one conveyor carrying the coal from the storage hopper to the breaker; a second, directly underneath the other, taking the coal to an elevator, which feeds two spiral conveyors for the filling of the coal-stores. The floor of the stores is inclined at an angle of 24°, to facilitate supplying an underground conveyor with the coal required for the hoppers of the bench of inclined retorts. All the motors for the installation are electrical; the current being taken from the town at 500 volts. Compared with the Liegel horizontal arches at the same works, the fuel account for the Stettiner-Chamotte inclined retorts is very high; being 17·5 per cent. for the latter, and only 7 per cent. with large coke, or 13 per cent. with small coke, for the former. The cost per ton of coal carbonized is 3·97 frs. with the horizontal, as compared with 2·25 frs. with the inclined retorts, which thus show an economy of 42 per cent. M. Ymonet had a very long paper on two subjects: (1) On the accidental fouling of gas in gasholders and mains; and (2) on precautions to be taken in verifying the purity of gas. Another long paper was read by M. Lecomte on intense incandescent gas lighting by gas exhausters; and M. Syssoyeff gave an historical review on "Gas and its Competitors in the Past, Present, and Future." MM. Cabrier, Chevalet, Jouanne, and others, also contributed papers.

The annual dinner of the Society was held on Wednesday evening at the Hôtel Continental. The visits included one to the works in progress for next year's Exhibition, another to the warehouse of the Paris Gas Company; and a third to the electric light works on the left bank of the river—all of which were well attended.

THE ASSOCIATION OF GAS AND WATER ENGINEERS OF AUSTRIA-HUNGARY.

The Eighteenth Annual General Meeting of this Association was held in Vienna, from the 1st to the 4th inst., under the presidency of Herr H. Nachtsheim, of that city.

The President welcomed the members and their friends at a reception on the evening of the 1st inst.; and on the following morning he opened the proceedings by reading the annual report of the Association. The report stated that there were 3 honorary members and 139 members; and that numerous applications for membership had been received. It was throughout of a satisfactory nature, and was adopted with acclamation. The President was then re-elected for another year. Herr G. F. Berthold, Manager of the Gas and Water Works at Pressburg, was elected Vice-President; and it was decided, in deference to his wishes, to hold next year's meeting in that town.

The technical papers were then read; the first being by Herr T. Herrmann, of Vienna, on the new central gas-works for that city. Herr J. Bernauer then gave a report on the recent Acetylene Exhibition at Buda-Pesth. Herr Blum, of Berlin, was unable to be present, owing to business engagements; and Herr A. Florin acted as his substitute in reading some "Notes from Practical Experiences." Herr Nachtsheim next lectured on the "Dellwik-Fleischer System of Water-Gas Production." This lecture evoked a lively discussion, in which Dr. Strache and Herr Gerdes took prominent parts. In the afternoon of the second day, the members visited the new Municipal Gas-Works in Vienna, and were much impressed with the large scale of the installations, which were described by Herren T. Herrmann and G. Wobbe.

On the third day, Heer van Vriesland, of Amsterdam, described his patent "Aërogene-Gas Apparatus," which was discussed by Herren Theodorowicz, of Lemberg, Wobbe, of Vienna, and the President. Herr Salzenberg, of Krefeld, then showed a spherical gaslight which seemed likely to prove a powerful competitor with the electric arc light. Herr Schoene, of Dessau, next described some "Novelties in Cooking Apparatus;" and Professor von Lang gave a lecture, which was illustrated by many experiments, on "Liquid Air," in the Physical Institute of the University. The members dined together in the evening, and on the following day participated in a very successful excursion to the lovely Höllen Thal in the Lower Austrian Alps.

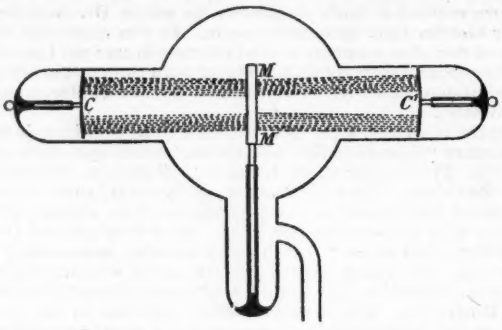
THE LUMINOSITY OF THE RARE EARTHS.

Our readers may remember that, in the course of his lecture at the meeting of the Institution of Gas Engineers, Professor Vivian B. Lewes referred to the valuable researches of Dr. Bunte (some account of which appeared in the "JOURNAL" early last year) into the comparative value of the various materials employed in the production of incandescent gas-light. The Professor stated that the investigations referred to showed very small differences in the intensity of the radiation from carbon, magnesia, pure oxides of thorium and cerium, and the Welsbach mixture; and he went on to say that within the previous week confirmation had been given of Dr. Bunte's results by an extremely interesting paper communicated to the Royal Society (through Lord Kelvin) by Mr. A. A. Campbell Swinton. The author has favoured us with a print of the paper, which appears in Vol. LXV. of the Society's "Proceedings" under the title of "The Luminosity of the Rare Earths when Heated *in Vacuo* by Means of Cathode Rays;" and it is reproduced below:—

For incandescent gas mantles, it is found that certain definite mixtures of the rare earths are necessary in order to obtain the maximum luminosity. For instance, in the ordinary bunsen gas-flame, a mantle consisting of pure thorium oxide or of pure cerium oxide will only give about one-eleventh of the light that is given by a mantle composed of 99 per cent. of thorium oxide and 1 per cent. of cerium oxide, which is the mixture at present used by the Welsbach Company. In order to explain this remarkable fact, several different and somewhat contradictory theories have been propounded, one of which implies catalytic or other chemical action between the oxides and the constituents of the bunsen flame.

In order to investigate this question, it is obviously important to note the behaviour of the rare earths at high temperatures without contact with any flame; and endeavours have already been made to effect this by heating the oxides in specially constructed furnaces. Under these conditions, only very minute differences could be detected in the amount of light given by different oxides and mixtures; but it appears doubtful whether the very high temperature of the bunsen flame was really attained. It has occurred to the writer that very high incandescence could be produced by enclosing mantles in a vacuum tube, and subjecting them to bombardment by means of cathode rays, when the mantles would not be in contact with anything except the cathode rays themselves and the comparatively small amount of residual gas that remains in the tube at the requisite high degree of exhaustion.

Since the date of Sir William Crookes's early researches, it has been known that a very high temperature could be produced in a body placed at the focus of the convergent rays from a concave cathode. In this manner, Crookes melted platinum and glass, and brought carbon wood to bright incandescence. The writer has made many experiments on this subject; using, instead of the interrupted continuous currents employed by previous investigators, alternating electric currents, which appear to have many advantages for this purpose. At the Royal Institution, in February, 1898, the writer showed that very brilliant incandescence could be obtained for a short time in a small block of lime, placed in a suitably exhausted tube midway between two concave electrodes, connected to an alternating electric supply at about 6000 volts pressure; and in June, 1898, at the Royal Society, he exhibited in action a similar arrangement, but with the block of lime replaced by a flat plate of thorium oxide. In this case, the concave electrodes were of such a curvature, and were placed so far apart, that the two sides of the thorium plate in each case intersected the diverging cone of cathode rays. Under these conditions, nearly a square inch of the thoria surface on each side of the plate became highly incandescent, and a very powerful light was obtained for some minutes at a time, but only at a critical and highly unstable degree of vacuum. The writer has applied this method to the investigation of the comparative luminosity of different mixtures of the rare earths.



One form of the tube employed was constructed as shown in the diagram, where C C′ are two spherically concave discs of aluminium 1·125 inches in diameter and 6 inches radius of curvature. These electrodes are placed about 7 inches apart, and were connected to the secondary terminals of a 10-inch Ruhmkorff coil, the primary of which was supplied through a variable resistance, with alternating electric current at 100 volts pressure from the main. The tube was connected, through a drying-tube containing phosphorus pentoxide to a pair of Toepler pumps; and also to a M'Leod gauge. The mantle M M to be experimented upon was mounted on a platinum wire frame, and placed between the two electrodes, so that as the electric current alternated, and each electrode became in turn cathode, the mantle was subjected on alternate sides to cathode ray bombardment. The curvature of the electrodes was such as to give almost parallel beams of cathode rays; so that a considerable ring-shaped, and slightly hollow, area on each side of the mantle was subjected to the rays, and could be brought to high incandescence.

A preliminary experiment was made with a mantle of asbestos, powdered over in patches with pure thorium oxide. With this it was found that, at a suitable degree of exhaustion, the patches of thoria became brilliantly incandescent, with an intensity of cathode rays that made the asbestos barely red hot. Experiments were next made with mantles consisting entirely of thoria and ceria, both separately and mixed in different proportions. These mantles were prepared in a similar manner to the Welsbach incandescent gas mantles, by saturating a carefully purified cotton fabric with ammonium nitrate of thorium and cerium, and then burning out the cotton. Very thick and closely woven cotton lamp-wick, freed from foreign matter by treatment with caustic soda, hydrochloric acid, and ammonia, was employed in place of the thin fabric usually employed, so that the resulting mantle, after burning out the cotton, was very close in texture, and fully 0·2 inch thick. This was found necessary, as otherwise some of the cathode rays passed through the mantle and melted the opposite aluminium electrode.

In order to obtain accurate comparisons between pure oxides and different mixtures, the mantles were made in patchwork; each complete mantle being made up of two or four sections, separately impregnated with different solutions, and then sewn together with impregnated cotton before being burnt. The mantles were so mounted in the vacuum tube that the cathode rays impinged equally upon the portions that consisted of different mixtures, so that an equal amount of energy was imparted to each sample.

With a compound mantle prepared in this way, composed one-half of pure thorium oxide and the other half of a mixture of 99 per cent. of thorium oxide *plus* 1 per cent. of cerium oxide, it was found, after exhaustion, that on starting the cathode discharge the thoria *plus* ceria heated up to incandescence more rapidly, and on stopping the discharge cooled more rapidly, than the pure thoria. Further, when kept at full incandescence, and observed through a dark glass, the thoria *plus* ceria was slightly more luminous than the pure thoria, though the difference was very small—probably not more than 5 per cent. Owing to the difficulty of maintaining a constant vacuum, accurate photometrical measurements were not possible; but the amount of light under favourable conditions was roughly estimated at, at least, 150-candle power per square inch of incandescent surface—this being obtained with an expenditure of electrical energy in the secondary circuit at about 8000 volts pressure of approximately 1 watt per candle. The amount of exhaustion suited to give the best results varied with the dimensions of the tube and the conditions mentioned below, but it was approximately about 0·00005 atmosphere; the maximum luminosity being obtained when the dark spaces of the two cathodes just crossed at the centre of the bulb. Owing to the large amount of gas occluded by the mantle, a proper degree of permanent exhaustion was very difficult to arrive at, and required continuous pumping for many hours with the cathode rays turned on at intervals. Even then the conditions of maximum luminosity were exceedingly unstable, owing on the one hand to the further liberation of occluded gas, and on the other to the rapid increase in the degree of exhaustion due to absorption of the residual gas by the electrodes. That such absorption probably took place in the aluminium electrodes, and not in the mantle, was demonstrated by other experiments with a tube in which there was no mantle, but only two electrodes of aluminium wire.

After the cathode rays had been allowed to bombard the mantle for a short time, the latter was found to have become discoloured where bombarded. The portion which was composed of pure thoria became dark blue, while the thoria *plus* ceria became brown. This effect, which appears to be analogous to those observed by Goldstein with lithium chloride and sodium chloride, seems to be due to a partial reduction of the oxides by the cathode rays. The admission of a very minute quantity of air to the tube while the cathode rays are acting on the mantle, and the latter is in parts incandescent, causes the discoloration to disappear instantaneously on the incandescent, but not upon the cool portions, probably by re-oxidation of the partially reduced oxides; while the discoloration also slowly vanishes in a day or two with the mantle cold, if air at ordinary atmospheric pressure is admitted to the tube. By continuing to bombard the mantle with cathode rays, and alternately allowing the vacuum to increase and letting in small quantities of air, the discoloration can be made to appear and to disappear over and over again as often as desired. At the moment of admitting air, the amount of light was found momentarily to increase; this being probably due to the increased temperature due to the re-oxidation of the partially reduced oxides.

After repeating several times this process of letting in small quantities of air and allowing them to be absorbed, it was found that the degree of exhaustion which gave the maximum incandescence had altered from 0·000047 to 0·000112 atmosphere, as measured by the M'Leod gauge. Similar effects were obtained with a tube containing no mantle, but only aluminium wire electrodes; the inference being that some change takes place in the residual gas which renders it less conducting.

At a higher degree of exhaustion than that which produced incandescence of the mantle, the pure thoria was found to fluoresce blue, and the thoria *plus* ceria with a yellowish light. The fluorescence in each case was much less bright when the oxides were white than when they had become discoloured by previous bombardment. With very high exhaustions, the thoria *plus* ceria fluoresced the more brightly; at lower exhaustions, the pure thoria gave the brighter fluorescence.

On the suggestion of Mr. W. Mackean, the tube was pumped up to a very high vacuum, and oxygen admitted. A similar experiment was made with hydrogen; the tube being completely filled with the gas, and then pumped to the proper degree of exhaustion. Though at low exhaustions these gases gave distinctive appearances to the discharge in the tube, no difference in the behaviour of the mantles with them and with air could be detected when once the vacuum reached the degree required for producing incandescence of the mantle.

Further experiments were made with a similar tube containing a compound mantle made up of four sections, composed as follows: (1) pure ceria, (2) pure thoria, (3) 50 per cent. thoria and 50 per cent. ceria, (4) 99 per cent. thoria and 1 per cent. ceria. With an intensity of cathode rays that gave a brilliant light with Nos. 2 and 4, Nos. 1 and 3 were found to give practically no light, becoming barely red hot; while, as before, No. 4 was found to give slightly more light than No. 2, and to heat up and cool more rapidly than the latter.

These experiments show that thoria and ceria, both alone and mixed, behave quite differently when heated by cathode ray bombardment than when heated in a bunsen flame. In the latter, 99 per cent. thoria *plus* 1 per cent. ceria gives many times as much light as pure thoria alone; while, when incandesced by cathode rays of equal intensity, the difference, though in a similar direction, is exceedingly small. Again, in the flame, pure ceria gives about the same amount of light as pure thoria; while with a given intensity of cathode ray bombardment, thoria gives a brilliant light, while ceria gives practically none.

In arriving at any finally satisfactory theory of the luminescent properties of the rare earths, these results with cathode rays, which differ materially from those obtained by other methods of heating, will require to be taken into account.

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

We complete to-day our report of the proceedings at the annual meeting of this Association by giving a *résumé* of the paper read by Mr. W. G. PEIRCE (Richmond) and of the discussion thereon. The subject was—

AUXILIARY TOWN SUPPLIES.

In his introductory remarks, the author reminded the members of references which were made to the question of dual supplies at the Nottingham meeting of the Association, and also called attention to information which he had obtained from Mr. D. M. F. Gaskin and Mr. J. T. Rodda. Within the scope of a paper, the author could not enumerate all the towns at present economizing the domestic supply by the dual system; and therefore he limited himself to four examples—two using salt water, and two river water.

He first described the complete road-watering and sewer-flushing installation at Bournemouth, from particulars furnished by Mr. F. W. Lacey, the Borough Engineer. It appears therefrom that it consists of about 20 miles of distributing mains, and two compound condensing steam-engines, drawing water direct from a pump from the sea, and forcing it through two 6-inch rising-mains to two towers at a height of about 175 feet Ordnance datum. The quantity of water used for the purposes named averages 21·75 gallons per head of the population per day. The flushing of sewers receives the greatest possible attention. There are 45 automatic flushing-tanks at the dead-ends of sewers, with a discharging capacity of 600 gallons in from 1¼ to 3 minutes after starting. In addition, the dead-ends of every sewer (about 120 in number) are connected with the salt-water mains by 3-inch sluice-valves, discharging from 200 to 300 gallons per minute. The water used for domestic supply averages 25 gallons per day, making a total consumption, including domestic water, of nearly 47 gallons per head per day.

Mr. J. W. Cockrill, of Great Yarmouth, furnished the following particulars respecting the auxiliary salt-water installation for private baths, street-watering, flushing drains, and extinguishing fires in the town. The Council, prior to establishing their own sea-water works, used to pay 1s. per 1000 gallons to the local Water Company, while the cost of their own enterprise is 1½d. per 1000 gallons, which covers all expenses, including repayment on a 30 years' basis. During the first few years, only 40 million gallons were raised each year; but for the past eight years above 100 million gallons have been pumped per annum. It has been determined to spend £3000 on new pumps, to be driven by electricity, capable of raising 25,000 gallons per hour, so that the available supply will be doubled (200 million gallons a year), and the cost reduced from 1½d. to 1d. per 1000 gallons.

Mr. Arthur Peirce, son of the author and Assistant-Engineer to the Corporation of Calcutta, says that city affords a typical example of the successful adoption of the dual supply. The works for the water supply are some 14 miles distant, at Pulta, upon the banks of the Hooghly, and the water necessitates large settling-tanks and filter-beds. The distance of the intakes from the city is rendered necessary by the fact that tidal action carries brackish water some distance above Calcutta. The expense of delivering water to the city being considerable, it was determined to provide a separate supply of unfiltered water. A pumping-station was erected on the banks of the Hooghly in the heart of the city, and a separate system of pipes laid. The scheme came into operation in 1874, the works having cost Rs. 238,224 for a potential supply of 2 million gallons per day—with the rupee at 2s. equalling £11 18s. per 1000 gallons of daily supply. In 1883, it became necessary to remove the pumping-station; and the opportunity was taken advantage of to provide new and improved machinery of greater power, and an extension of piping for a daily supply of 4½ million gallons at a cost of £18 7s. per 1000 gallons of daily supply—the supply of filtered water at this time (1884) being above 20 million gallons per day. At the time this information was furnished (August, 1898) £50,000 was being spent on the extension of the installation. The improvement thus inaugurated will, it is thought, have a beneficial effect upon the health of the town by the more systematic flushing of the branch sewers. The cost of the filtered water supply, including all charges and interest on loans, amounts to 2·4 annas, against 4·4 pies for the unfiltered supply with the rupee at 1s. 4d. (4 pies=⅓d. and 1 anna=1d.).

The author next dealt with his own works at Richmond, Surrey. The dual road-watering and sewer-flushing system was introduced in the summer of 1883, when, owing to the insufficient supply of water available for domestic use, road-watering from this source was stopped. In consequence, the author erected a small direct-acting pump, 9 in. by 5¼ in. by 12 in., in the boiler-house, and connected it up with an old 3-inch disused main of the Southwark and Vauxhall Water Company, leading to the corner of the main street in the town. Here it supplied a fire hydrant for the purpose of filling the water-carts. As time went on, a further extension became necessary; and an additional section of the old Southwark main was requisitioned, and hydrants fixed for facilitating the road-watering more completely. With this extension, sewer flushing on a systematic plan was inaugurated; and having seen from this small beginning how satisfactory and economical the constantly-charged and high-pressure dual system of mains had proved, the author advised making the auxiliary system a permanent institution, and proposed laying new mains on future extensions, and to replace those requisitioned and on hire. The borough at this time was growing fast; Kew, Petersham, and North Sheen being added. Notwithstanding that these places were within the Southwark Company's district of supply, the Corporation, for economical reasons, decided to extend the auxiliary service to the added parts for road-watering and sewer-flushing; and the water was charged for by meter at the rate of 6d. per 1000 gallons—the Water Company's charge having been 8½d.

The advantage and economy to Richmond has been considerable. The auxiliary supply mains being under a constant pressure nearly double the domestic-supply pressure—varying between 80 lbs. and 120 lbs. per square inch—has proved of great assistance in extinguishing fires, and in saving time in filling water-vans, and for garden watering and a variety of business uses. The charge for the water is 6d. per 1000 gallons when taken by meter, and for garden watering by area up to 600 square yards (ranging from 8s. to 20s. per annum), and above this area by meter at 6d. per 1000 gallons. The Corporation Highway Department pay £1000 per annum for all the water required within the parish of Richmond. With regard to sewer flushing, this is regularly attended to by two men constantly engaged in the service; and not being metered for this purpose, the water is liberally drawn upon.

There is without doubt, in the author's opinion, a distinct advantage as regards economy in a dual supply, and more especially in having fresh water, as against sea-water, even allowing that salt water can be used the whole year round for sewer-flushing and other sanitary purposes, and is not therefore a summer installation only. With river or any other than sea-water, there is always a constant demand. In his own case, the total quantity of water pumped for the supplementary service in the year ending March 31 last was 70,598,066 gallons, averaging 193,419 gallons per day. The maximum consumption during July and August reached an average of 272,654 gallons per day; and the minimum during January and February averaged 146,779 gallons per day. The total consumption of water, including the domestic supply, during the year was 285,337,900 gallons, averaging 781,747 gallons per day, with a maximum during the months of July and August of 946,561 gallons per day, and a minimum for January and February of 677,561 gallons per day; so that nearly one-fourth of the total service is provided by the auxiliary supply, and is still increasing. The garden-watering services are now laid on free of cost up to the boundary of private property.

The author gave the following particulars as to the cost of the auxiliary installation as at present constituted:—

	£	s.	d.
Two Worthington type pumps (each capable of pumping 300 gallons per minute) complete, including erection, suction-pipes, and connections, with existing 6-inch rising-main, steam, vacuum, and water-gauges	898	0	0
Two depositing wells, 5 feet diameter by 30 feet depth, 9-inch brick in cement	80	0	0
Two 6-inch syphon pipes laid from wells to the bed of river	44	0	0
One 4-inch cast-iron syphon for connecting the two wells	6	0	0
Total value of mains, 15 miles 33 yards, as laid by Corporation workmen	6123	17	3
Sixty-one 2½-inch fire brigade hydrants, fixed complete	213	10	0
Eighty-nine flushing branches	314	16	9
	£7680	4	0

The working expenses and capital account on the auxiliary service for the year ending March 31 last is based on an estimated capital expenditure of £7600:—

	£	s.	d.
Interest, say at 8 per cent. per annum on £7600 for 15 years	608	0	0
Rent of pipes in River Thames, per annum	25	0	0
Coal (Nixon's), allowing 10 lbs. per 1000 gallons, at 17s. 7d. per ton	266	6	0
Repairs to machinery, &c.	50	0	0
Oil, tallow, waste, packing, &c.	20	0	0
Extra labour (cleaner for works)	65	7	0
	£1034	13	0

The estimated cost per 1000 gallons for pumping 70,598,066 gallons, including repayment of principal and interest on loans for the past year equals 3½d., and, not including the repayment of capital expenditure, 1·45d. per 1000 gallons.

The estimated income for the past year derived from the auxiliary water service was as follows:—

	£	s.	d.
Highway Department for road-watering and sewer flushing, which also included street works not metered	1000	0	0
Ninety-five garden supplies charged on area	79	7	2
Highway Department added areas, 4,081,100 gallons at 6d. per 1000 gallons	102	0	6
Water for trade purposes, gardens, water-motors, &c. 19,786,100 gallons at 6d. per 1000 gallons	494	13	0
	£1676	0	8

Whatever arguments may have been made against the dual supply system, the author hoped he had made it clear that—under certain conditions, and where authorities are working with only a narrow margin of domestic supply, and where no increase of supply can possibly be expected within the boundaries of the authorities—an auxiliary plant might advantageously be adopted, and the necessity for going further afield averted for many years. The cost of the dual system is infinitesimal as compared with

the cost of a new establishment which must probably be set up some miles from the town, and from which an additional supply is only required for (say) three months in the year. As an instance, at Richmond the consumption for nine months in the year does not exceed 27 gallons per head of the population for all purposes; whereas during a few weeks of the summer 42 gallons per head is an absolute necessity. In most places water unfit for domestic purposes is abundant; and the only question is whether, if obliged to put up a new and separate pumping-station at a distance from the principal works, it will pay to introduce a dual supply. As such a case, Bournemouth may be cited, where a small pumping-station has been put up in the public gardens, and so designed as not to offend the eye or prove a nuisance to the public. Gas-engines were first used at that station, but steam power has since been substituted.

Discussion.

Mr. E. A. B. Woodward (Wolverhampton), in moving a vote of thanks to the author, remarked that it was not every town which was so situated that they could adopt an auxiliary supply of salt or river water. But at the same time the subject was one which was worthy of serious consideration.

Mr. H. Preston (Grantham), having inspected Mr. Peirce's auxiliary installation, was perfectly satisfied he had accomplished all he claimed in the paper. He had himself felt that to water the streets and flush the sewers with pure water, which had cost so much brain power and money, was a waste; and if it were possible, it would certainly be advisable to have a secondary supply for these purposes. There were, however, some objections to a dual service. Where, for instance, there were two mains in a street, it was quite possible for the wrong one to be tapped, and great mischief might thus be caused. Then children might drink the inferior water from garden taps; and this might be detrimental to their health. Where a dual supply was provided, in his judgment it should only be used for flushing sewers, street watering, and manufacturing purposes, and should not be supplied to dwelling-houses under any consideration. He had pleasure in seconding the motion.

The motion having been unanimously passed,

Mr. W. A. Richardson (Birkenhead) observed that the question of dual supplies turned entirely upon the points of cost and distance from which the auxiliary water would have to be carried. Where they had nothing but wells to depend upon, such a scheme would not be practicable.

Mr. A. Christie (a member of the Richmond Town Council) said they were proud of their Water Engineer, who had done a great deal for the water supply of the town. The auxiliary service was especially useful, because the domestic supply was rather limited. Only at the previous Council meeting, it was decided that for garden purposes the river water should be laid on free up to the premises; and this had produced a large number of applications. This would not only result in a great saving of pure drinking water, but would bring in a considerable revenue. No such accident as that suggested by Mr. Preston had occurred at Richmond; and he did not think it was probable it would.

Mr. H. Ashton Hill reminded the members that at a previous meeting Mr. Kirby, of Batley, stated that he had a dual system; but he supplied the same quality of water in both mains—one containing water at high pressure for fire extinguishing and trade purposes, and the other water at a lower pressure for domestic uses. In connection with this question, towns situated on rivers had an advantage over sea-coast towns, as salt water could not be used in the summer time for garden purposes. Alluding to the fixing of private fire-hydrants, he asked the author whether it was the practice in his case to charge something for the privilege as well as for the maintenance of the hydrants, and whether they were sealed. It would also be interesting to know, in addition to the particulars given, the cost of pumping 1000 gallons per 100 feet head. He thought the author had overlooked the use of oil-engines for pumping; and he instanced a case where only this type of engine was suitable, owing to the locality being an isolated one.

Mr. Hamlet Roberts (Ipswich) asked for information as to the class of boiler Mr. Peirce used, the evaporation duty he obtained from the coal for which he paid 17s. 7d. per ton, and the effect the river water had upon water motors and mains. As to private fire-hydrants, he had about fifty fixed at Ipswich. The proprietors had to pay the cost of fixing; and the Water Department made a charge of 10s. per annum for the hydrant and water used. Each hydrant was sealed, and notice had to be given before it was broken.

Mr. W. Jones (Pontypridd) stated that he had to supply a district varying from 100 to 500 feet. He supplied this by means of one main; and he had some difficulty in maintaining sufficient pressures during dry seasons. Another trouble he had had was due to the local Councils not being careful in appointing men who would exercise care in taking water from the mains. Only recently one of the men, in drawing water from a main (he believed through carelessness), broke a hydrant, and deprived a large district of water. Regarding fire-hydrants, he had been called upon to fix a hydrant in a timber yard; and, in endeavouring to come to an arrangement with the owner, he (Mr. Jones) suggested he should pay 10s. 6d. a quarter for it, or £2 2s. per annum. The owner challenged his right to make a charge for the use of the hydrant, arguing that the Company were compelled to supply water for fire purposes free of charge. He should like to know whether water companies had the right to charge for such conveniences.

Mr. Percy Griffith (London) said he might venture to reply to the last speaker. Unless Mr. Jones's Private Act excluded the clause, he was bound under the General Act to afford a constant supply of water, at a sufficient pressure, for fire-extinguishing purposes. Turning to Mr. Peirce's paper, he complimented the author upon the very full figures he had supplied, which showed that he realized a very handsome profit—apparently something over £600—from his auxiliary supply. He noticed that in one installation referred to by the author gas-engines had been supplanted by steam-engines. His own experience, and that of others, was that gas-engines had been found most suitable for pumping purposes; and he had never heard of any other form of motive power superseding them on the points of economy and general convenience. This suggested that there might be special circumstances attaching to these auxiliary supplies which made a difference. While congratulating Mr. Peirce on having dealt with the subject in such an eminently practical way, he said there were probably some present who, like himself, would have welcomed a little reference to the general theoretical deductions which were capable of being drawn from the author's own experience. Some of them were interested in more works than one, and were anxious to consider carefully whether the duplicating of the supply would be an advantage. He was especially interested in Essex; and, speaking generally of that county, he might say the question there was becoming an acute one. At Clacton a duplicate supply had already been introduced, owing to there not being sufficient water under the ordinary supply to meet the demand. Of course, Mr. Peirce was fortunate in being on a river, the water of which was suitable for all purposes other than drinking, without filtration.

Mr. Richardson denied that there was any compulsion to supply private fire-hydrants; and consequently a water company could make their own arrangements in regard to them.

Mr. Hill wished to add that the practice in his own Company was to fix the hydrants on private premises and seal them up; but they did not charge for them, as they did not want to accept any responsibility in regard to them.

The President (Mr. William Watts) remarked that where salt water was used on the streets, and evaporation took place, the saline matter must be left behind; and what effect this would have upon the streets and shopkeepers he was not prepared to say. Still, it was one of the points water engineers might take into consideration. With regard to the dual system of water supply, it seemed to him it would be very advantageous to introduce it into districts under the gravitation system. He thought Mr. Whitaker would bear him out when he said that the flood water of many of the Pennine valleys was much larger in proportion to the normal flow of the streams. These flood waters came at comparatively rare intervals, but in such large volumes that they had little or no conception of the enormous amount of water they yielded. He suggested that, if they had specially constructed reservoirs in the good sized valleys in which the flood waters could be collected, and the normal flow of the streams taken care of for the town supply, the former could be utilized for purposes other than domestic. In this way a great saving would be effected. Regarding Mr. Jones's statement that his district varied in its physical features from 100 to 500 feet, he was not at all surprised to hear that the pressure fell at the top part. If the mains were much larger, the hydrostatic pressure at the top of the district would not be felt to the same extent. Wherever they had water travelling at a velocity through a pipe, they could not have the hydrostatic pressure on the one side or the other. The simple remedy was to direct the supply to a convenient place, and put down a small receptacle into which they could pour the water from the district proper, and thence direct it to the top of the town.

Mr. Peirce, in reply, stated that at Richmond, to prevent any accident such as Mr. Preston alluded to, they affixed to the taps small enamelled tablets on which it was stated that the water was only serviceable for garden use, and unfit for drinking purposes. Touching the question of economy, he might say that, although they were paying off a heavy loan, they had reduced the water-rate to 10d. in the pound. One of the advantages of the dual system was that of being able to have a high and low pressure—the former for fire brigade purposes, and the latter for house service. He found this prevented a great amount of waste. Where private fire-hydrants were put into closed premises, and there was no possibility of the water being used for garden purposes, no charge was made; but where a hydrant was fixed, and the water was likely to be so used, he put on a 3-inch meter, and charged 10s. a year, which included the maintenance of the meter. As to the cost of pumping the water per 1000 gallons, he put it at rather a high figure; but it did not work out at quite 1¼d. per 1000 gallons—that was pumping into the main, and maintaining a pressure from 80 to 120 lbs. per square inch. The level of the roads varied from 16 to 140 feet Ordnance datum. As to why the gas-engine at Bournemouth was displaced by steam power, the reason given to him by the man in charge was that the cost of the gas was too expensive. Oil-engines could not very well be employed in the middle of a town, as they emitted a very unpleasant smell. Respecting the boilers, he had no room for horizontal boilers, and so put in old vertical

ones. When these boilers were tested some time ago, they gave 11 lbs. of evaporation. The river water had no detrimental effect on motors or meters. From the information before him, he did not think there was any objection to the use of salt water for street watering; and there were numerous other purposes to which it could be applied. He concluded by acknowledging the vote of thanks.

REGISTER OF PATENTS.

Incandescence "Baskets."—Imray, J.; a communication from Julius Moeller, of Palmer Street, Westminster. No. 14,191; June 27, 1898.

This invention relates to the manufacture of "incandescent baskets" of the kind employed years ago by Clamond and others, and which were made by weaving or netting together threads of refractory material produced by squeezing a paste of magnesia or other earth through a die. The object of the present invention is to obtain the refractory material, not only in a state of fine subdivision, but also in such a condition that the finely subdivided particles are themselves porous—the result being that the basket produced is said to be very light, and when it is incandesced is much more luminous than baskets consisting of particles which, however finely subdivided, are not themselves porous.

In order to manufacture a basket made up of porous particles of refractory materials, some organic substance having cellular structure—such, for instance, as cotton or pith—is impregnated with a solution of a salt of the refractory earth, and is incinerated at as low a temperature as possible. The ashes are passed through a fine sieve by rubbing with a brush. An organic substance, such as starch (or a mixture of starch with gluten or gelatine, or wheat flour), is mixed with a solution of a salt of the refractory earth, and warmed until it thickens. It is then thoroughly mixed, and incorporated with the sifted ashes above described, so as to form a paste. This paste is squeezed through a die, forming flexible threads, which are woven or netted together to form incandescence baskets. These baskets are heated in a closed chamber, or in a reducing medium, so as to carbonize the organic ingredients; and they are then baked at a high temperature in an oxidizing medium or flame, so that the carbon is burnt off, and the salt is decomposed—leaving a basket of the earthy matter in a porous condition.

Automatically Varying the Load and Pressure of Gas-Governors.—Cowan, W., of Edinburgh. No. 14,225; June 28, 1898.

In patents No. 9829 and No. 18,855 of 1892, the present inventor described his system of regulating the loading and unloading of gas-governors by means of the pressure of gas in a remote district. In the latter of the two inventions, an electrical means of communication between the auxiliary gasholder (or pressure-vessel) in the distant locality and the governor—in the gas-works or elsewhere—was described; and it is to this part of the invention that the present improvements relate.

The patentee now proposes to dispense, as far as may be practicable, with the wires hitherto employed for electrically bridging the distance between the governor-room and the distant pressure-vessel; and to employ a system of "wireless telegraphy" (such as has been at work, experimentally, between Bournemouth and the Isle of Wight, and elsewhere), with suitable apparatus and arrangements for the working of the system, and for its adaptation to, and combination with, his older system of pressure regulation.

Water-Heating Apparatus.—Simmance, J. F., and Abady, J., of Page Street, Westminster. No. 15,084; July 9, 1898.

The patentees propose the use of an aspirating jet or an exhausting fan in the outlet-flues of water-heaters or "geysers;" the jet being formed, and the fan worked, by the water supplied to the heater before such water has come in contact with the means provided for heating it. They also suggest the use, in connection with water-heaters, of the now well-known form of Kern atmospheric burner.

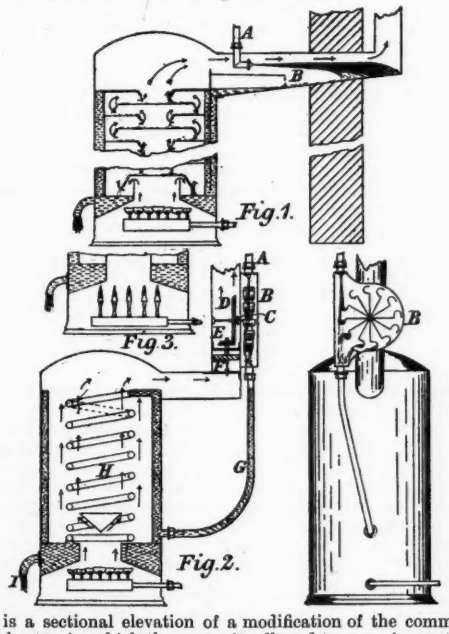


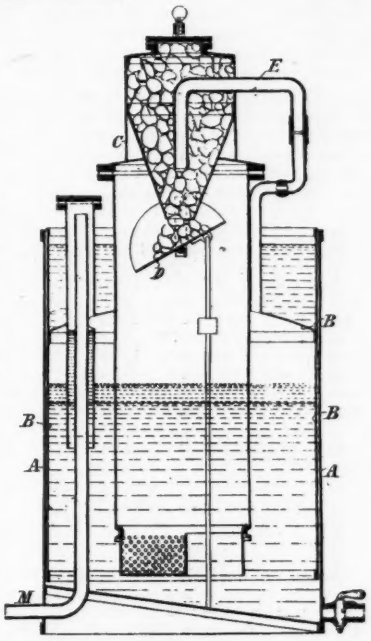
Fig. 1 is a sectional elevation of a modification of the common form of water-heater, in which the water is allowed to come in contact with the products of combustion. The cold water enters at A, and issues in the form of a jet along the outlet-pipe B. Its impetus being lost, the water falls to the bottom of the pipe B, and runs back into the heater, where its temperature is raised by contact with the heated gases.

Fig. 2 shows the invention applied to an ordinary coil form of water-heater, in which the water is not allowed to come in contact with the products of combustion. The water passes along a spiral tube or coil heated by gas. The cold water enters at A, and fills (or it may be impinges upon) the buckets of the turbine B, causing it to revolve. The spindle of the turbine passes through a stuffing-box C, which prevents any water escaping into the outlet-pipe. It is fitted with a bevel-wheel D gearing into another bevel-wheel E, to the spindle of which is fixed an exhausting fan F. The cold water, after passing through the turbine (causing it, and consequently the fan F, to rotate), flows down the tube G, and into the heater, where, passing through the spiral coil H, it is raised in temperature, and passes out at the outlet I.

Fig. 3 shows an adaptation of the Kern burner (patent No. 294 of 1897) to the base of a gas water-heater.

Acetylene Generators.—Bohne, M., of Berlin. No. 15,423; July 13, 1898.

The characteristic feature of this acetylene generator is that the gas, as it passes from the centre of generation to the place where it is to be consumed, is compelled to traverse the portion of the carbide which is piled up in a box above the slide cover of the generator, and which is to serve for the next following portion of gas to be generated. In this way, as the gas comes in contact with the carbide, it gives off its moisture, and a superficial calcination of the carbide takes place. "The advantages thus obtained consist, on the one hand, in the generated acetylene gas being dried, and, on the other hand, in the fact that the carbide superficially calcined by the absorption of water will, as it is subsequently used, not so energetically produce its gas, but will do so in a uniform and regular manner."



In the arrangement shown, A is the water-reservoir, and B the dome or bell, the cylindrical wall of which extends above the top of the dome so that a space is formed above it, which, when filled with water, serves to exert a pressure upon the dome. The bell is provided with a central tubular insertion, and with a gas-receiving tube, fitted with a sieve-shaped bottom adapted to retain the non-reduced carbide. It carries at the top the carbide receiver C. At the lower end of this hopper-shaped receptacle, a balance D with regulating-rod is provided. Within the receptacle C terminates a downwardly bent gas-pipe E, connected with the gas-pipe of the dome by means of a sliding joint; and for cutting off the communication between the dome and the tubular insertion, a cock is arranged in the gas-pipe of the dome.

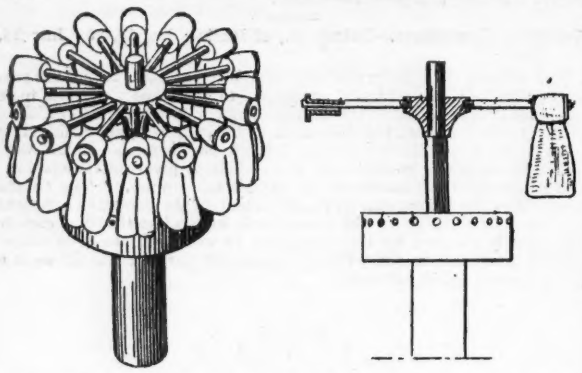
The reservoir A is filled with water, and the box C with carbide; and the regulating-rod of the balance or rocking device D is put out of contact with the bottom of the vessel. If now, on starting the apparatus, the air existing in the dome is discharged, or if the withdrawal of the already generated gas be such that the dome descends, the regulating-rod will strike against the bottom, and cause the balance to turn, so that carbide is thrown into the water. The generation of gas thus effected causes the dome to ascend. As the generated gas, saturated with moisture, can only escape by passing through the column of carbide resting on the balance-device D (which column is always supplemented from the carbide receptacle C, and serves for the subsequent generation of gas), the generated gas gives off its moisture to the carbide, and is utilized in a dry state. The moisture given off to the carbide, causes a layer of lime to be formed upon the surface of the carbide; and this layer, during the subsequent use of the carbide, prevents the gas from being generated too rapidly. The generated gas, dried by giving off moisture, passes through the pipe E into the space with in the dome, and into the gas-receiving pipe. From the latter, it passes through a discharge-pipe M to the place of consumption. Prior to the generation of gas, petroleum would be poured into the gas-receiving pipe, so as to prevent the water from coming in contact with the dried gas.

Incandescent Lighting Apparatus.—Léry, J. B. de, of New York. No. 19,167; Sept. 8, 1898.

This invention mainly relates to an incandescence gas-burner, whereby great efficiency is attained, and the replacing of injured portions of the

incandescing body is accomplished without the necessity of renewing the entire incandescing element. The invention also includes details of construction relating to the means for supporting the incandescent material.

The illustration shows a perspective view of the complete burner, and a side elevation with parts broken away. In patent No. 9940 of 1897, a burner was described in which the incandescing material was in the form of a continuous tufted ring made up of layers of incandescing material bunched and pressed together at their upper edges, and leaving the lower edges free and more or less separated, so as to permit the heat of the flame to enter. The gas-outlets were in a drum of smaller diameter than the ring of incandescent material; and the flames projecting from the sides of it impinged against the lower edges of the ring. The patentee has since learned that, "while all the benefits of the mutual support of the layers of the incandescent material are obtained by this



construction, there still remains an obstacle to the highest state of incandescence, which is the fact that the tufts are so crowded together that there is not sufficient freedom for the circulation of air round about those portions of the burner which furnish the incandescence." He therefore proposes to retain the ring-like shape, and separate the tufts or bunches, so as to provide a free air-space between the adjacent tufts. In patent No. 2365 of 1898, a particular form of tuft that might be used singly or with others bunched together, was described; but in this case the means for conveniently supporting and replacing the single tuft were not specified. In the present instance, the inventor claims what he now believes to be the most practical and efficient form of burner of this class that can be devised; and "while the difference of construction over the two cases above referred to are not great, yet those differences, such as they are, afford distinctly advantageous results."

The frame upon which the incandescent bodies are supported consists of a central hub, from which radiate a series of arms or spokes, on the outer ends of which the tufts of incandescent material are hung. The gas flows from openings in a drum arranged concentrically below the support for the tufts; and it is of a less diameter than the ring of tufts, so as not to cut off the rays of light. The circumferential distance between the extremities of the arms is such as to afford an open space for the circulation of air round each tuft; and "since the entire lower portions of the tufts are thereby brought to a higher state of incandescence, the spaces between the tufts, when the burner is in operation, become obliterated, and the burner has the appearance of a continuous ring of light."

The burner is said to be admirably adapted to street lighting, on account of its ability to resist shocks and jars without breakage; and in case a tuft is injured, the burner is not rendered useless, for those remaining will continue to furnish light. An injured tuft may be replaced by a good one without interfering with the others; and this is an important advantage of the invention, for in the earlier form of this burner, while it was possible to separate an injured tuft from the others, it could not be done without the greatest care and sometimes not at all, because after burning awhile mantles in contact with each other are likely to become welded together.

The tufts of incandescent material here referred to are preferably those of the character described in the patents already named—that is to say, "they are made of the usual fragile layers as sheets folded or placed together in such a way as to bring them into supporting contact with each other at one edge, while they are separated at the other edge to admit the heat of the flame."

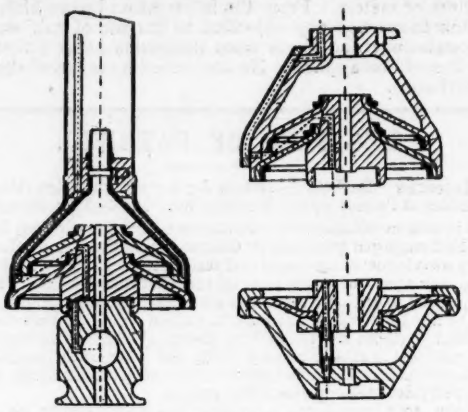
Anti-Vibrators for Incandescent Gas-Lamps.—Smith, R. H., of Victoria Street, S.W. No. 24,956; Nov. 26, 1898.

This device for preventing vibration in incandescent gas-lamps is placed below the burner so that the vibration may not affect the steadiness of the flame, but above the gas tap or cock, so that the manipulation of the tap or cock shall not shake the mantle.

The device consists essentially of a conical or cup-shaped hollow piece of metal, across whose base are clamped "thin non-metallic flexible sheets or diaphragms of a material impervious to gas, and having a low modulus of resilience." Either the tap is attached to the centre of the sheets and the burners to the metal cup, or else the burner is fastened to the centre of the sheets and the tape to the metal cone. The material of the flexible sheets is of a kind not to be affected to an injurious degree by contact with gas, or by such heat as reaches it by conduction or radiation from the burner above it.

In some descriptions of lamp, a thin sheet of vulcanized rubber, with or without canvas webbing, serves the purpose; but when the disc is exposed to more heating, "asbestos sheet," with or without rubber, canvas, or metallic webbing, is more suitable. This material, in the form of thin sheets clamped at their edges only, has also the advantage of transmitting less vibration than does rubber. Thin leather thoroughly saturated with oil or fat may also be used for the flexible discs; as may any kind of sheet which is impervious to gas, which is without high resilience, and which is chemically and physically unaffected to an injurious degree by contact with gas or by moderate heating.

The metal cone or cup may be placed (as shown) with its broad base and the flexible sheet or sheets at the top; but the patentee generally



prefers the inverted position with the base downwards—this position giving the sheets greater protection from the heat, and also affording to the burner more stable support.

Regenerative Gas-Burners.—Maturin, D. C., of Earl's Court, W. No. 2371; Feb. 2, 1899.

The patentee proposes to fix a return-pipe to the neck of the burner, through which the gas has to flow before it can reach the point of combustion; the upper end of the return-pipe being of ring or other shape within or outside the chimney. If within the chimney, it is preferably arranged in or above the top of the flame, with an internal opening for the free passage of the products of combustion; if outside the chimney, it can be about level with the hottest part of the flame, where the ring is gradually heated by conduction, instead of directly, as by the former method.

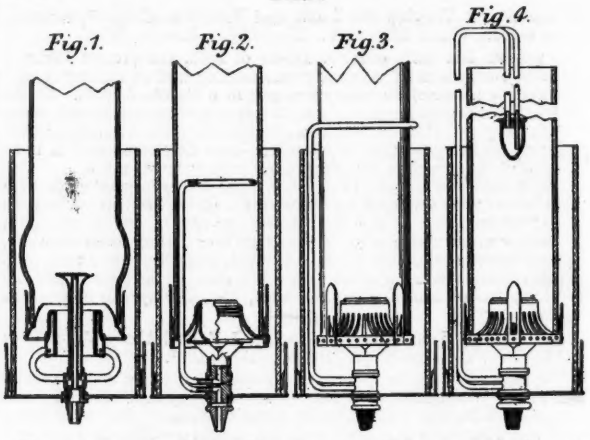


Fig. 1 is a sectional elevation of an argand burner with the gas-heater flow-and-return tube within an inner chimney, and having a gas-heating chamber at the top.

Fig. 2 is a part sectional elevation of an argand burner with the gas-heater tube having a ring top with an inner chimney.

Fig. 3 is an elevation of such a burner with the gas-heater tube outside the inner chimney; the upper part of the gas-heater tube being of ring-shape, with the return leg affixed to the neck of the burner proper where the direct flow passage is blocked, in order that the gas in its travel is diverted.

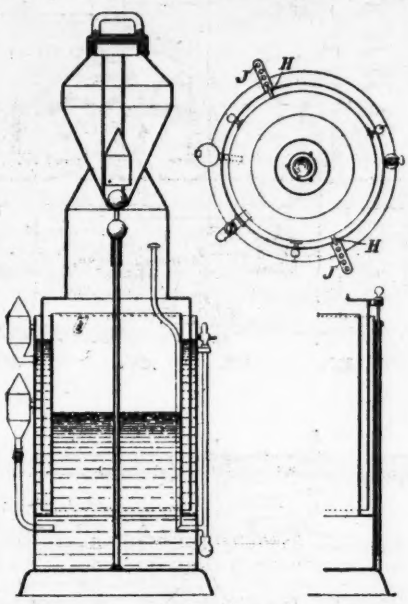
Fig. 4 is a part sectional elevation of an argand burner with two gas-heater tubes springing from the neck, and rising up outside the inner chimney, where they are bent over and terminate in a bulb, within which "the gas can be expanded by the heat of the flame, and so become thinner and rendered more adapted for perfect combustion than by the previously referred to ring-tubes."

The patentee prefers in each case to employ two chimneys (as indicated), "because the air to support combustion is rarefied before reaching the flame, and, in addition to be the better prepared for supporting combustion, it produces by its steady gentle flow a more regular and equable flame without risk of flicker or jump—the light being of great brightness and purity, with plenty of diffusion properties."

Acetylene Generator.—Combier, A., of Pierre Bénite, France. No. 6925; March 30, 1899.

As shown, the generator is formed of a double reservoir with a single bottom; the interior reservoir receiving the water to react on the carbide, and the exterior one the gas-bell, which ascends and desends therein. In the middle of the upper part of the bell is an automatic feed-hopper for the carbide, tapering downwards, and having at its lower end an opening. A rod passes through the opening, and carries two valves in the form of spheres, one above the other below the opening. The valves are spaced for a distance apart equivalent to the amount of a single charge of carbide. To relieve the valves from the superincumbent weight of the carbide in the hopper, a roof-like shelter is suspended near the mouth of the hopper; so that it lies over the valve with only sufficient space left around the edge to permit carbide to leave the hopper. A gas-tube rises within the bell; while funnels on the opposite side are provided to fill the two compartments of the double reservoir.

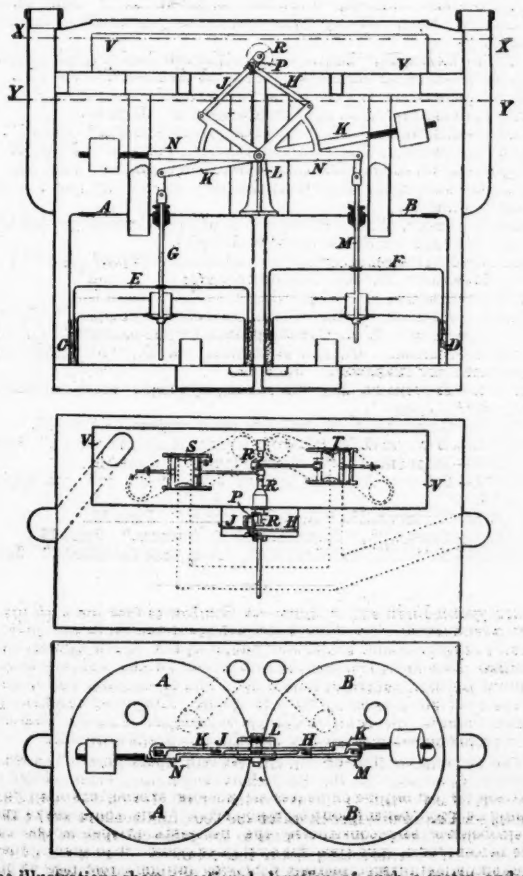
The parts being in the position shown (the reservoir compartments being charged, and the hopper also, and the latter closed, while the bell is held by the pins H and plates J in such a position that the valve closes the hopper below), the plates J are now folded down and the pins H



released. The bell will then fall, and carbide will pass under the valve, which cannot fall further owing to it resting on the end of the central pipe. Carbide thus falls into the water, and gas is developed, which raises the bell, allowing the valve to again fall on its seat so that the supply of carbide is stopped. That which has fallen, being not yet exhausted, is presumed to be sufficient to provide a full charge of gas; and when the latter has been used, the bell, in falling, will eventually pass again below the position illustrated, another charge of carbide will fall, and the process will be repeated unless the fall of the bell is limited by the engagement of the plates J and pins H.

Gas and Other Fluid Meters.—Greenall, J., of Leeds. No. 4886; March 6, 1899.

This is a modification of the patentee's well-known type of meter, in which two pistons actuated by a rocking beam are employed for measuring the gas.



The illustrations show a sectional elevation of such a meter, and sectional plans on the line X X and Y Y.

A and B are two cylinders, having inner portions which form annular spaces C and D at the bases. Bells E F are situated within the cylinders, the lower ends immersed in glycerine seals in C D; thus preventing the gas to be measured from passing between the opposite sides of the bells. The bell E is suspended by a piston-rod G, passing through a stuffing-box, and connected with one end of a rocking beam K, mounted on a bracket L. The opposite end of the lever carries an adjustable weight, which balances the bell E and parts connected with it. The bell F is suspended by a piston-rod M, which (passing through a stuffing-box) is connected with a rocking beam N, also fulcrumed on the bracket L, and the opposite end of which carries an adjustable weight to balance the bell F and its parts.

The rocking beams are formed with arms or triangular extensions on their upper sides, and are connected by rods H and J with an adjustable pin of a crank P, which has a circular motion, and is carried on the extremity of a crank-shaft R. The rising and falling of the bells E and F therefore communicate motion to the shaft; and as the bell E is set half a stroke in advance of the bell F, no dead-point is obtained in the crank. The arms enable the crank-shaft to be situated in the centre of the meter; and the advantages obtained by this central situation of the crank-shaft are duly set forth.

V is a box in which are the valves S and T; and the crank-shaft R passes into the box through a stuffing-box. The slide-valves S and T are situated over their respective bells E and F, and are actuated through connecting-rods from cranks set in position a quarter of a revolution apart. The gas entering the valve box is fed alternately on opposite sides of the bells E and F—thus causing them to rise and fall like the pistons of a steam-engine; and the movement of the bells imparts the necessary motion to the crank-shaft, and thence to the slide-valve; while the gas that is expelled through the passages to the outlet-pipe represents the supply from the meter after its quantity has been duly registered. The amount of gas passed per stroke therefore depends on the length of stroke given to the bells E and F; and this may be regulated by adjusting the pin in the crank P. The movements of the crank-shaft are communicated to counting mechanism, and this may be conveniently performed by means of a slotted crank and shaft.

Gas-Heating Furnaces for Inclined Retorts.—Derval, E., of Paris. No. 7526; April 10, 1899.

The patentee remarks that, since their introduction for the manufacture of illuminating gas, inclined retorts have not given very good results, chiefly in consequence of the difficulty of heating them economically and regularly. Furthermore, the necessity there has been of placing the combustible gas-producer in such position that it projects beyond the retort-bench, in order to have space enough for the regenerators and the smoke-flue, has rendered it very difficult to construct the furnaces properly. In some installations, the charging of the producer and the cleaning of the fire-bars have been done behind the retort-benches; but it has then been necessary to make use of a special floor or platform for charging the producers, so that there were required three different stages—one for charging the retorts, one for charging the producers, and one for discharging the coke.

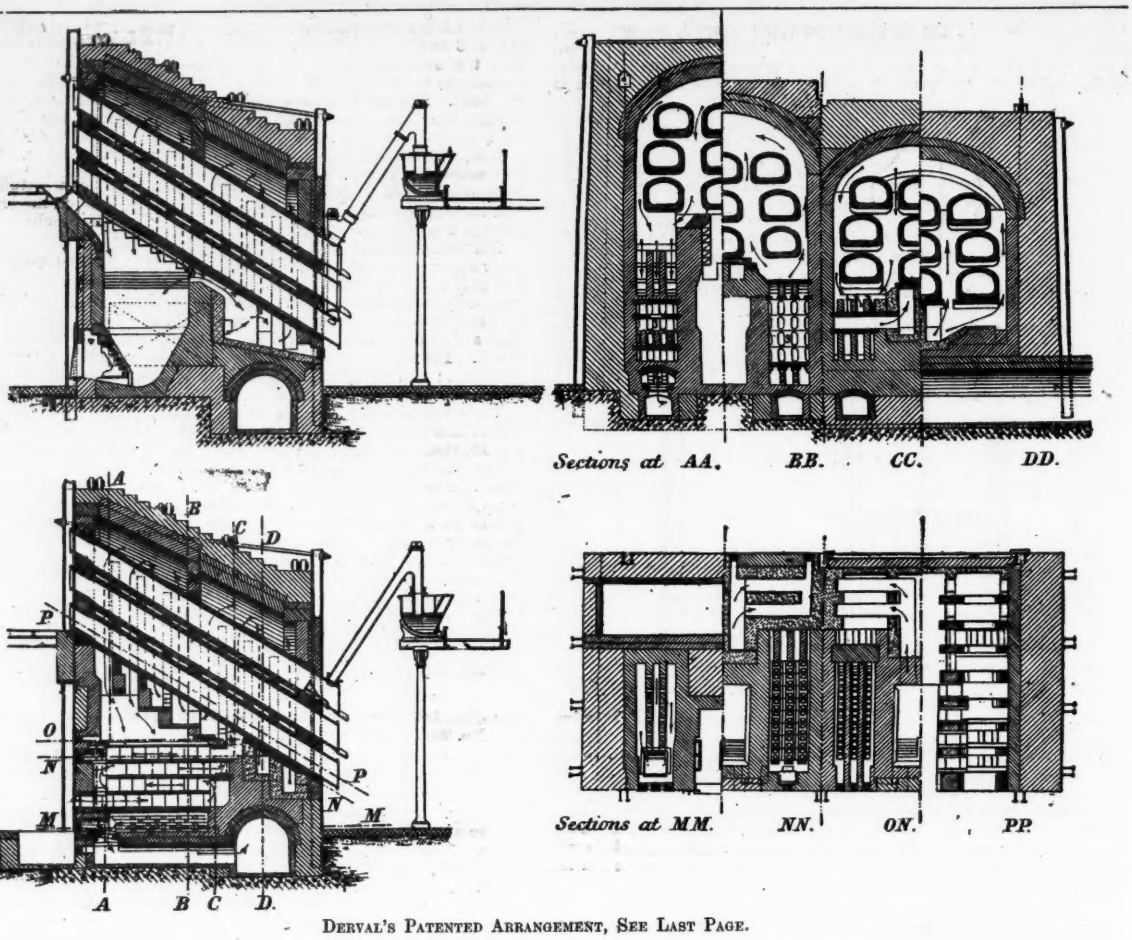
It will be seen from the engraving (next page) that the gas escaping at the bottom of the producer can be raised to as high a temperature as may be required by the introduction of a sufficient quantity of air; and by regulating this first admission of hot air by the damper provided for the purpose, "the bottom of the retorts can always be raised to the required temperature." As regards their upper part (which does not require to be raised to so high a temperature for a good distillation), it is only necessary to open appropriately the damper which regulates the second inlet of hot air. The small inlets for air at each side of the charging opening of the producer are simply for partly turning the gas in the producer when, for example, in consequence of the employment of coal as fuel, the distillation is not perfect in the retort placed directly over the producer.

The patentee says he attaches great importance to the use of this arrangement of furnace; for it enables him to obtain not only a very regular heating of the retorts with coke, coal, or tar, but also a notable reduction of the quantity of fuel consumed, in consequence of the better utilization of the heat of the flame or of the products of combustion. Furthermore, the successive combustion to which he subjects the gases before sending them to the regenerator, prevents the cutting action of the fire on the retorts; and the duration of the latter is thereby increased.

This method of heating may also be applied to furnaces of seven and eight retorts; also to furnaces having only two vertical rows of retorts—furnaces with two, five, and six retorts. In the latter case, the producer is placed at the side of the furnace, under one of the lower retorts. For furnaces having two horizontal rows of retorts, it is sufficient to omit, in furnaces with seven, eight, and nine retorts, the second row of retorts, without altering the furnace or the position of the producer.

Sliding of the retorts and leakage of air through the front walls are prevented by the employment of a covering of cement, in which are embedded the horizontal iron bars which hold in place the cast-iron mouthpieces of the retorts. The ends of these bars are held by small bands of iron riveted to the stanchions, and other supporting ironwork of the retort-bench. This ironwork does not project at all beyond the face of the retort-bench, which is a great advantage when the removal of the coke is effected with waggons or a quenching conveyor is employed.

The patentee prefers to arrange the ascension-pipes and hydraulic main for inclined retorts in a manner which differs entirely from what has heretofore been employed. In retort-benches for illuminating gas, the ascension-pipes which convey the gas from the retorts to the hydraulic main are, he says, usually arranged vertically—whether the hydraulic main is placed in front or not of the face of the benches or furnaces. The result of this is that the weight of the pipes acts directly on the cast-iron mouthpieces, and tends to detach them from the retorts. Furthermore, the pipes being very close to the face of the bench or furnace are greatly heated, and the tar deposited in them prevents the free escape of the gas. To obviate these inconveniences, he inclines the ascension-pipes, and places the hydraulic main at a tolerable distance away. By these means "the weight of the ascension-pipes acts much less powerfully on the mouthpieces of the retorts; and as the pipes diverge from the face of the furnaces, their contact with the cold air prevents the deposit of the tar in them, and the obstructions occasioned thereby." It



DERVAL'S PATENTED ARRANGEMENT, SEE LAST PAGE.

is also obvious that, "instead of contributing to the sliding downwards of the inclined retorts, the pipes oppose such sliding, since they bear against the face of the furnace by the intermediary of the small feet cast on the upper part of the cast-iron elbows a little below the cleaning plugs."

APPLICATIONS FOR LETTERS PATENT.

11,135.—WORSNOP, C. W., "Acetylene lamps." May 29.
11,157.—BEESE, R., "Self-lighting gas-burner." May 29.
11,263-4-5.—ABEL, C. D., "Two-stroke gas and oil motor engines." A communication from H. Eckhardt. May 30.
11,318.—MAIN, R. B. & A. P., and SHERBURN, W. H., "Gas-stoves." May 31.
11,431.—LIVESEY, G., "Street-lamps." June 1.
11,474.—COLLIER, F., and CAREY, T., "Protector for the prevention of breakage of incandescent mantles." June 2.
11,483.—THE READ-HOLLIDAY ACETYLENE COMPANY, LTD., CARDNO, W., and ARUNDEL, H., "Purification of illuminating gas." June 2.
11,491.—POTTER, W. G., "Gas-burners." June 2.
11,494.—HILBERG, E., "Acetylene generators." June 2.
11,537.—DEIMEL, F., "A portable igniter for gas-lamps and gas heating apparatus." June 2.
11,551.—THOMPSON, W. P., "Acetylene lamps." A communication rom T. Morin and A. Straguin. June 2.
11,593.—KEITH, J., "Gas or air compressors or pumps." June 5.
11,638.—RAY, I., and JONES, H., "Obtaining gas from fluid hydrocarbon." June 5.
11,639.—RALPH, J., and JORDAN, J. A., "Gas-cookers." June 5.
11,653.—ARMINGTON, C. F., "Incandescent mantles for gas-burners." June 5.
11,727.—GRAHAM, M., "Elevating and conveying machinery." June 6.
11,790.—GAJARDO, A., "Gas-motors." June 6.
11,850.—RIORDAN, D. V., "Incandescent gas-mantles." June 7.
11,868.—GUILLAUME, N. A., "Apparatus for washing gas." June 7.
11,884.—BENDER, O., and DURST, F., "Acetylene producing machine." June 7.
11,893.—JAMES, R. W., "Carburetting appliances." A communication from E. Zimmermann and E. Mégret. June 7.
11,939.—HARTLEY, J., "Supporter and extender for incandescent gas-mantles." June 8.
11,951.—KIRKNESS, R., "Holding incandescent mantles upon their burners." June 8.
11,960.—VERWER, C., "Acetylene lamps." June 8.
11,980.—EMMERSON, G. W., "Acetylene gas-generator." June 8.
11,993.—SCHNEIDER, B. von, "Steam and gas filter." June 8.
12,012.—ELLIOTT, C., DAMP, G., and M'DADE, J., "Cleaning or scraping ascension-pipes." June 9.
12,047.—BOULT, A. J., "Manufacture of water gas." A communication from E. Fleischer. June 9.
12,048.—HILL, H., "Incandescent mantles." June 9.
12,053.—THORN, F. S., and HODDLE, C., "Generating and storing acetylene gas." June 9.
12,077.—M'KEAN, W., "Incandescence mantles." June 9.
12,087.—BOULT, A. J., "Production of acetylene gas." A communication from P. Dumont. June 9.
12,139.—GUILLAUME, N. A., "Gas-generators." June 10.
12,150.—LÉBY, J. B. de, "Incandescent gas-burners." June 10.
12,195.—SPENCE, W. L., "Air and other gas heating furnaces." June 12.
12,210.—HAIGH, B., "Burners for acetylene and other gas." June 12.
12,244-5.—LANCHESTER, F. W., "Gas and oil motors." June 12.
12,273.—KENNEDY, J. E. & H. L., "Gas-meters." June 13.
12,295.—GUILLAUME, N. A., "Purifying gas." June 13.
12,303.—ISSELS, F. G. M., "Generating acetylene gas." June 13.
12,339.—ROSENTHAL, A., "Incandescent gas-burners." June 13.
12,357.—NEW, A. G., "Internal combustion engines." June 14.
12,393.—CREWE, H. T., "Automatically controlling gas and other valves." June 14.
12,429.—BOULT, A. J., "Production of incandescent gas-light." A communication from E. Salzenberg. June 14.
12,434.—RAWLINSON, A., "Gas and oil motor engines." June 14.
12,449.—COGAN, P., "Gas and other engines." June 15.
12,470.—GRAHAM, M., "Conveying hot coke." June 15.
12,471.—HERRING, W. R., "Storing and discharging coal." June 15.
12,481.—STERNE, A. J., "Igniting device for gas-burners." June 15.
12,484.—BARGAMIN, C., and BATCHELOR, O. D., "Automatic cut-off attachments for gas-stoves." June 15.
12,485.—TEICHMANN, H., "Obtaining cyanogen combinations from coal gases." June 15.
12,496.—CHAPELLE, J. M., "Gas or other engines." June 15.
12,551.—WALKER, C. M., "Burner for incandescent lighting." June 16.
12,615.—SALSBURY, H., "Acetylene lamps." June 16.
12,619.—BARRON, A., and RIDLEY, J. J., "Oil and gas engines." June 16.
12,631.—SALSBURY, H., "Acetylene lamps." June 16.
12,655.—FASTRÉ, F., "Incandescent gas-burners." June 17.
12,659.—NOWAK, G., and KLEMM, P., "Acetylene generators." June 17.

Acetylene Lighting in Syra.—A Greek engineer has established in Syra a good-sized installation of acetylene gas; and the Municipality have already adopted it for lighting the public square, a few streets, and the market. The clubs, restaurants, and private houses are also taking it up gradually. The generator and fittings are of German make, and the calcium carbide is imported from Belgium. The present cost is equivalent to about 4s. 3d. per 1000 cubic feet of coal gas. This is a little cheaper than petroleum—the only other illuminating agent available.

The Reconstruction of the St. Helens Gasholder.—The Gas and Lighting Committee of the St. Helens Corporation have decided to recommend the Council to accept the tender of Messrs. Ashmore, Benson, Pease, and Co., Limited, of Stockton-on-Tees, for the above work; the firm having undertaken to fix new bases to the guide-columns in place of the broken ones, without taking down the columns. The work of cutting out and removing the damaged holder is almost completed; it having been done under the direction of the Engineer and Manager (Mr. Samuel Glover), by the workmen of the Corporation.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Future of the Gas Associations.

SIR,—The proceedings at the recent meeting of the Gas Institute show how greatly the desire for reunion has gained ground; and what is so generally felt would be of advantage to the gas industry should be worth striving for, even to the suppression of personal feeling or inclination. One great obstacle to unity seems now to have been removed; and the rest should not be impossible to accomplish.

If we are all agreed as to what, for the future, ought to be the sole qualification for membership, here is an opportunity for a new organization upon a wide and firm basis. The various District Associations have done excellent work in the past; but it can hardly be denied that some of them have, during the last few years, shown less vigour than formerly. Why should they not renew their youth as Sections of one great National Institution, upon the lines, say, of the Society of Chemical Industry, or the Association of Municipal Engineers? to which they would be a source of strength, and in the management and advantages of which they could participate.

This is not a new idea; but it may not be thought less deserving of consideration on that account.

CHAS. HUNT.

Birmingham, June 23, 1899.

The Carbonizing Wages of the Crystal Palace Gas Company.

SIR,—For myself, I should certainly not trouble you; but for the credit of others, I ask your permission to correct a very extraordinary and misleading mistake in dealing with figures (this is not the place to deal with misstatements pertinent to the inquiry) made by the man of figures in his evidence before the Committee on Metropolitan Gas Charges on Tuesday last. He said that the carbonizing wages of the Crystal Palace District Gas Company were 3s. 7d. per ton, the same as the Chartered. Such a figure cannot be found in "Field's Analysis." The highest was 3s. 4·8d. in 1890, and the next highest 3s. 4·48d. in 1897—the year presumably to which reference was being made. But at the time the witness was speaking his "Analysis" for 1898 was already in print, for which year the figures are 3s. 2·3d., though for the first time they are only given at per 1000 cubic feet sold.

Dividing into half years, the highest point was in the June half of 1897; and since then there has been a gradual decrease, which is the very satisfactory feature of the case—thus: June, 1897, 3s. 5·86d. per ton; December, 1897, 3s. 4d. per ton; June, 1898, 3s. 3·5d. per ton; December, 1898, 3s. 1·1d. per ton. The last figure would have been lower had stokers' wages not been increased in October, 1898.

The rates of wages are the same as the Chartered Company. The comparison is therefore fair; but it may be contended that the amount paid in profit-sharing should be added. The proportion paid to retort-house men does not exceed 1½d. per ton; but even with this added, 3s. 7d. cannot be made for any year.

The essential difference between the two Companies is this—the little one is rapidly improving in every way; the big one is either standing still or going back.

GEORGE LIVESEY.

Crystal Palace District Gas Company,
June 24, 1899.

The Recent Engineering Conference.

SIR,—In the discussion on Mr. Foulis's paper, as printed in your issue of June 13, there is a reporter's error which I shall be glad to see corrected. In speaking of the heating properties of Mond gas, I stated that the calorific value of the gas obtained was over 80 per cent. of the calorific value of the slack put into the producer; but I made no such meaningless statement as "able to obtain a gas with a flame temperature 80 per cent. over* that of the original heating value of the slack."

While on the subject, will you permit me to add a few remarks on Mr. Charles Hunt's letter in the same issue of your paper. The amount of carbonic acid in Mond gas being higher than in other producer gases, Mr. Hunt regards this excess as "the loss of fuel which appears to result from gasification at the low temperature of the Mond process." The fact that so many others are, at first sight, disposed to take Mr. Hunt's view of the matter only shows that Mond gas holds a unique position with regard to other producer gases which is not yet thoroughly understood even by some eminent gas engineers.

As now made at Winnington, Mond gas contains by volume: 16 per cent. CO_2; 11 per cent. CO; 29 per cent. H; 2 per cent. CH_4; and 42 per cent. N. A cubic foot of this gas at 0° C. has a calorific value of 158 B.T.U., or considerably more than a cubic foot of Siemens producer gas, which contains only 5 per cent. of carbonic acid. No ordinary producer gas has so much hydrogen in it; and Mond gas owes much of its heating value to this constituent, which is only obtained in such large quantities at the expense of fuel burnt to carbonic acid. Over half-a-ton of steam is decomposed in the Mond producer for every ton of fuel gasified; but having thus obtained our heating value in the resulting hydrogen, it is impossible to have as much in other forms—such as carbonic oxide. "One cannot have one's cake and eat it too." But the balance remains in favour of the Mond producer; for no other can show a gas with over 80 per cent. of the calorific value of the fuel used—not to mention the large recovery of ammonia in the process, and the cheap fuel used.

It is true that the flame temperature of Mond gas is not high (2000° Fahr.) if the cold gas be burnt with cold air. But in these days, when regeneration is so well understood and so easily carried out, this offers no difficulty. With the Mond process, the maximum of heating value in the gas can be obtained with the minimum of cost; so what does it matter whether the calorific value is mostly derived from carbonic oxide or from the hydrogen of decomposed steam?

H. A. HUMPHREY.

Northwich, June 21, 1899.

* It is clear that the mistake arose through the transposition of the word "over."—ED. J. G. L.

PARLIAMENTARY INTELLIGENCE.

Gleanings from the Committee Rooms.

The Bristol Gas Company's Bill has run its course through the Committee stages. It came, in the form in which it left the Lords, before the House of Commons Committee, presided over by Sir Henry Fletcher last Thursday week; and three days were occupied in its discussion. The result is that the position of the Company has been strengthened in no inconsiderable degree, but they have lost some of the interesting features of the measure as originally introduced. The capital powers asked for have been allowed; and this alone makes the Bill a valuable one. In addition, some incidental requirements for improving the working facilities of the Company have been granted. Some modifications, however, were made in the conditions asked for with regard to the examination of consumers' fittings; but the power of the Company to supervise arrangements as to the supply to consumers have been improved. The main contest before the Commons Committee was over the relief which the Company sought from the obligation imposed upon them by the Act of 1853 to supply gas to the public lamps within the city "at a price equal to the lowest price charged for the time being by the Company to any private consumer." In other words, the Company desired that this clause should be construed to mean (as could only have been its intention at the time it was framed) the lowest price charged to any private consumer for gas used for lighting purposes, and that it should not be binding in respect of the price charged for purposes other than lighting. The Lords Committee upheld the Company's contention; but the Commons Committee have seen fit to deny the Company the release prayed for, or to consent to an alternative—the repeal of the objectionable clause, and the submission to arbitration of the price to be charged for gas supplied to the public lamps.

This decision perpetuates the inequality of the positions occupied respectively by the Company and the Corporation as suppliers of light and power; and now the former will have to continue to fight the competition of the latter with, as it were, their "hands tied behind them." In the "Gleanings" on a previous occasion, the injustice of this was pointed out; and the views then expressed may be emphasized by the arguments of a gentleman who was interested in the Bill. Chatting over the matter with him, he readily admitted that personally he quite sympathized with the view that local authorities ought to have gas for public lighting at the lowest rate fairly possible. The fact that they are the official custodians of the roads, and that gas companies are an "abominable nuisance" to them—that they have as trading companies the right to open and use the roads without any rent except the rates paid upon the mains—is a solid reason why the inhabitants *qua* ratepayers should be treated liberally. But in this case, he recognizes a great distinction; the Corporation being not only the representatives of the ratepayers, but also a trading community, competing with the Gas Company for business. With the electric light they have been, and will be, successful in taking away a great deal of the Company's profitable lighting, although the price they charge is dearer, light for light, than that charged for gas. The Corporation propose to go farther than this, and to charge a rate for power purposes so low that, standing alone, it would not pay expenses; and with this rate they intend to compete with the Gas Company for custom for power purposes. Besides this they have taken from the Company the lighting of some 10 miles of roads, and those the most profitable—leaving the Company the supply of the outlying and most unprofitable districts. Under these circumstances, to claim that the bargain of 1853 should be so read that the Company are not to be permitted to compete with the Corporation for power unless they are served at an equally low rate for street lighting is a hardship, and it gives the Corporation an unfair advantage in the competition. They are entirely unfettered as to the price they shall charge either for a day-load or for purposes other than lighting; while the Company are tied by the interpretation placed upon the clause passed nearly fifty years since. To say the least, there is something a bit impudent about the insistence of the Corporation in maintaining this condition in regard to the gas supply when palpably the only effect of it will be to aid the electric light. If the electric light were in the hands of a Company, the lower the price to which the Gas Company could get, the lower the price of the Electric Light Company would have to be brought; and so the Corporation and the town would be gainers. But as circumstances are, the Corporation of all people must be desirous of keeping up the price of gas; and from the way they dealt with the subject when before the Committee, it seemed that they regarded the very natural desire of the Gas Company to be in a position to compete with them as a sort of enormity. The decision, unfortunately, now precludes all possibility of competition on fair terms between the two bodies.

Few witnesses were called before the Committee. The Company's evidence was furnished by Alderman J. W. S. Dix (the Chairman), Mr. John Phillips (the Secretary), and Mr. Corbet Woodall; while the Corporation only called Mr. Thomas Newbigging.

Since the Scunthorpe Gas and Water Bill left the House of Commons, an agreement has been arrived at with Messrs. Cliff, the proprietors of the Frodlingham Steel and Iron Company, for the payment to them of £5560 for their gas-works. But we believe that had the owners come to an earlier settlement with the Council, they could have secured even better terms. However, the arrangement between the parties has had a doubly beneficial effect—it obviates the necessity for expense in an arbitration, and to some extent it shortened the proceedings last week before the Lords Committee to whom the Bill had been referred. The only opposition on this occasion came from Mr. R. J. H. Parkinson, a landowner, who objected to the site on which the Council propose to erect new gas-works. The evidence, however, of Mr. E. H. Stevenson, Mr. H. E. Jones, and other gentlemen satisfied the Committee that the site selected was the best for the purpose; and, moreover, their Lordships declined to grant Mr. Parkinson a compensation clause.

The Bill promoted by the Stockport Corporation to unable them to purchase the undertaking of the Stockport District Water Company and to supply water within prescribed limits, and also to confirm certain agreements relating to the supply of water by the Manchester Corporation, has lately been before a Committee of the House of Lords presided

over by the Earl of Camperdown. The Bill had successfully passed the House of Commons, notwithstanding the strenuous opposition of the Heaton Norris and New Mills District Councils, who again appeared against the measure. Mr. Pember, Q.C., the leading Counsel for the Corporation, gave an outline of the scheme, which is to cost about £750,000. He said the purchase was not desired with a view to making a financial profit, but to securing that the control of the water supply should be in corporate hands. In reference to the objections to the scheme, he mentioned that the New Mills District Council desired to supply Newtown. Stockport, however, were prepared to consent to the introduction of a clause compelling them to serve that place within eighteen months of the passing of the Bill. The Heaton Norris Council asked the Committee to insert the "model clause" in lieu of the Corporation's proposal as to the severance of any outside Local Authority. The Corporation suggested that any Authority desiring to sever themselves, must pay compensation based on the price the Corporation gave for the undertaking. The Committee refused to accede to the request, and allowed the clause which would enable any outside Authority to sever themselves on paying compensation under an open arbitration. With regard to Newtown, the Committee thought the District Council might be allowed to pay for the pipes and mains only. The Committee also decided that the ultimate profit of the water undertaking, after compensating the Corporation for any deficiency made good out of the rates, should be applied in reduction of the charges. According to the Bill as passed, from and after the day on which the measure receives the Royal Assent, the Corporation will come into possession of the undertaking which for so many years has supplied Stockport and the surrounding townships. The water is derived from several sources, including the Manchester Corporation, who are bound, under an old agreement by which they stopped the supply from one source, to sell a million gallons per day to the Company, and henceforth to the Stockport Corporation, at 2½d. per 1000 gallons. After disposing of the Corporation Bill, that promoted by the Stockport Water Company was dealt with. The measure practically depended upon the passing of the other Bill, and was one to give parliamentary sanction to two agreements with the Manchester Corporation for the supply of water to the Company at a price fixed some years ago. After hearing the arguments of Counsel, the Committee passed the Bill.

HOUSE OF LORDS.

The following further progress has been made with Bills :—

Bills brought from the Commons, read the first time, and referred to the Examiners: Bradford Tramways and Improvement Bill, Derwent Valley Water Bill, Godalming Corporation Water Bill, Walker and Wallsend Union Gas (Electric Lighting) Bill.

Bill read the first time, and referred to the Examiners: Local Government Provisional Orders (Gas) Bill.

Bills read a second time and committed: Blackpool Improvement Bill, Darwen Corporation Bill, Dublin Corporation Bill, West Gloucestershire Water Bill.

Bills reported, with amendments: Belfast Water Bill, Fishguard Water and Gas Bill, Fylde Water Board Bill, Stockport Corporation Water Bill, West Gloucestershire Water Bill, Wetherby District Water Bill, Wolverhampton Corporation Bill.

Bills read the third time and passed: Rhondda Urban District Council Bill, Wetherby District Water Bill.

Bills Royal Assented: Arbroath Corporation Gas Bill, Brigg Urban District Gas Bill, Broughty Ferry Gas and Paving Order Bill, Cambridge University and Town Gas Bill, Crowborough District Water Bill, Dumbarton Burgh Bill, Ilford Gas Bill, St. Albans Gas Bill, Stockton and Middlesbrough Water Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills :—

Lords Bills read the first time, and referred to the Examiners: Gas Orders Confirmation (No. 1) Bill, Gas and Water Orders Confirmation Bill, Water Orders Confirmation Bill.

Lords Bills read a second time and committed: Lowestoft Water and Gas Bill, St. Neots Water Bill.

Bills reported, with amendments: Bristol Gas Bill [Lords], Bury Corporation Bill [Lords], Bury Corporation Water Bill [Lords], Church Stretton Water Bill [Lords], Cobham Gas Bill [Lords], Menstone Water Bill, Stretford Gas Bill [Lords], Totland Water Bill, Warrington Corporation Bill.

Bills read the third time and passed: Bradford Tramways and Improvement Bill, Derwent Valley Water (Consolidated) Bill, Godalming Corporation Water Bill, Hastings and St. Leonards Gas Bill [Lords], Local Government Provisional Orders (Gas) Bill, Mid-Kent Gas Bill [Lords], Skipton Urban District Gas Bill [Lords], Walker and Wallsend Union Gas (Electric Lighting) Bill, Wishaw Water Bill [Lords].

Gas and Water Works Extensions at Barry.—Mr. W. O. E. Meade-King, one of the Inspectors of the Local Government Board, held an inquiry at the Gas and Water Offices, Barry Dock, on Wednesday respecting an application by the District Council for power to borrow £16,000 for the purposes of the gas undertaking, and £9270 for the water-works. The General Manager of the gas and water works (Mr. F. M. Harris), in answer to the Inspector, said the gas-works were capable of making 100 million cubic feet of gas per annum; and the consumption amounted to 96 million cubic feet. The consumption increased at the rate of about 23 or 24 per cent. each year, and was the most rapid increase in the country. In regard to the application for £9270 for water purposes, Mr. E. W. Waite, the Water Engineer, stated that it consisted of £7500 for water-mains and sewers, £1500 for extension of water-mains to Rhoose, and £270 from Rhoose to Fontigary. The consumption of water in the Barry district was between 500,000 and 600,000 gallons per day. At the close of the inquiry, the Inspector visited the sites of the proposed new works.

HOUSE OF COMMONS SELECT COMMITTEE.

Tuesday, June 20.

(*Sir* James Rankin, *Chairman.*)

THE POWERS OF CHARGE OF THE METROPOLITAN GAS COMPANIES.

The Select Committee of the House of Commons on the above subject met again to-day.

Mr. John W. Field was further examined.

The Chairman: I think you wish to make some remarks upon the alleged advantages of your Company over other Metropolitan Companies?

Witness: Yes. In Mr. Haward's evidence, he gave certain figures of the quantity of gas sold per mile of main by the three Metropolitan Companies respectively. The quantity returned by this Company was from 10¼ to 10½ millions; with the South Metropolitan it is the same figure; and with the Commercial 8½ millions. Therefore, as regards the present, the South Metropolitan Company and ourselves are equal.

Witness handed in the following table giving the gas sold per mile of main by each of the three Companies in the years 1883 to 1898:—

Year.	The Gaslight and Coke Company.	South Metropolitan Company.	Commercial Company.
	Thousands.	Thousands.	Thousands.
1883	8,569	5,964	6,314
1884	8,685	6,049	6,455
1885	8,886	6,490	6,715
1886	9,027	6,852	6,714
1887	9,219	7,110	6,806
1888	9,406	7,376	7,151
1889	9,755	7,403	7,261
1890	9,912	7,750	7,398
1891	10,214	8,247	7,823
1892	10,062	8,374	7,737
1893	9,542	8,154	7,396
1894	9,462	8,478	7,505
1895	9,900	9,151	7,760
1896	10,170	9,490	7,906
1897	10,506	10,062	8,484
1898	10,354	10,246	8,669
Rate of increase	20·83 p. ct.	71·80 p. ct.	37·30 p. ct.

The increase in the sale of The Gaslight and Coke Company in the period between 1883 and 1898 was 20·83 per cent.; of the Commercial Company 37·3 per cent.; while the South Metropolitan Company had had the enormous increase of 71·8 per cent. That was very important; for it was a great advantage to have as large a sale of gas as possible per mile of main, because it showed that the plant was carrying a good revenue. These figures would give the Committee some idea of the rapid increase in the sale of gas which was taking place in the South Metropolitan district. Although the sale of gas per mile of main was a very useful figure for purposes of comparison, it must not be taken altogether as an absolute figure, because the main might be a 3-inch or 40-inch one.

The Chairman: Could you give us any information as to what are the respective dimensions of the pipes?

Witness: None whatever. These figures must be taken with that qualification.

How much that qualification is you do not know?—No; but I think you may fairly assume that approximately the relative sizes of the mains in each Company's district are about the same.

Mr. Lough: What follows from this?

Witness: These figures show that relatively the increase in the South Metropolitan Company's district is very much greater than ours; and very much greater in proportion to their length of main—a very important factor in all calculations connected with gas lighting.

You do not make clear why it is an important factor?—The mains cost so much per mile of capital outlay. If on this capital you can get twice as much as your neighbour in quantity of gas sold, of course there is much greater advantage.

That is my point; they do not get twice as much?—I am only pointing out to the Committee that during the period under review the South Metropolitan were selling 5,900,000 cubic feet per mile in 1883 against our 8,500,000. Now they are selling 10,200,000, and we are selling 10,300,000. You see at once how rapid has been the increase.

The Chairman: Mr. Lough's point is that in 1883 your figures show you were doing a very much better business per mile?

Witness: Yes.

Now your figures show you are about the same?—Yes; you see they are rapidly overtaking us.

Mr. Lough: You are saying that is giving a great advantage. What we see on the figures is that you were reaping your harvest all the time while these poor people had to struggle up?

Witness: I am showing that the district of the South Metropolitan Company is increasing vastly more than that of The Gaslight and Coke Company; and I think the Committee will see what a very important factor that is in comparing the working of one Company with another.

Mr. Cohen: One would infer, from your arguments, that in the years that you did have the advantage there should have been a diminution in the difference of price; but this difference of price has been going on all the time.

Witness: Not quite in the same proportion.

The Chairman: Will you kindly proceed?

Witness: Another far more important matter is the competition which the Company has from the electric light. The district in which this competition is very keen is from the City in the east to Hammersmith on the west; from the City to Islington and Hampstead on the north; and, going south, to the Thames. According to the return furnished by the Electric Lighting Companies, the number of Board of Trade units they sold in our district during the year 1897-8 was 31 millions. Reducing that to its equivalent in gas, it is equal to 3000 million cubic feet, or one-

seventh of the whole of our supplies in the year. To enable the Committee to appreciate what these figures are, to give them some idea of the magnitude of the actual competition, I may say the annual consumption of gas in Leeds is 2286 million cubic feet, in Newcastle 2240 millions, and in Liverpool 3286 millions. Therefore the quantity of business we appear to have lost by the introduction of electric light is equal to the entire consumption of the whole of the city of Liverpool. We have provided plant, works, mains, &c., for the supply of this quantity of gas, and now it is taken away from us; and therefore to that extent, or approximately to that extent, the Company's plant is thrown out of gear. To some extent this competition will account for the decrease in gas sold in the years 1892-3-4.

Were those years of great electric activity?—During the past ten years electric lighting has been going on very rapidly indeed in our district; and that, concurrently with the mild winters to which I referred last time, accounts for a great many of the figures of decrease in our tables, and for our being here to-day.

Mr. LOWLES: I suppose your supply of gas for cooking purposes was largely increased.

Witness: Yes.

Mr. COHEN: You are aware that it is stated by some of the witnesses that the electric light competition has been assisted by the dear prices charged by your Company?

Witness: That is a fallacy altogether. If the electric light had been adopted because it was cheaper, we should have found it was used more largely than it is in the poorer districts; but you will find that the electric lighting runs all along the wealthy and rich parts of the districts. It is adopted because it has advantages over gas. It lends itself better than gas does to decorative purposes for shop windows, and things of that kind; and a very large number of people in the west-end prefer it in their houses.

Mr. NICOL: Can you give us any figures to show that in the area marked on the map as having the competition of the electric light there has been a diminution of the consumption?

Witness: In some districts there has been during some years. There has been an increase, in some districts, especially in the north-west and north-east. On the application of any consumer, whether he wants one light or fifty, the Company have to supply him with a service-pipe. As a rule, the service-pipe, which might be 50 feet long, is not put in till it is applied for. In 1898 over 1897, there were reductions in the consumption in Soho, the Strand, Regent Street, and Marylebone—the whole of the central district—averaging 2 per cent. In the northern, north-western, and southern areas, there was a small increase. It is in the central district and in the west that the competition of the electric light has been greatest.

The CHAIRMAN: Now as regards the cost of working?

Witness: In Mr. Haward's table, he makes a comparison between the cost of working for the years 1884 and 1898. The following table, which I have drawn up on the same lines as Mr. Haward's, extends the comparison back one year longer, for the reason that 1883 was the first complete year after the last amalgamation of The Gaslight and Coke with the London Company:—

	Gaslight and Coke.	South Metropolitan.	Difference in Favour of South Metropolitan.	Commercial.	Difference in Favour of	
					Gaslight and Coke.	Commercial.
	Per 1000 Cubic Ft.	Per 1000 Cubic Ft.	Per 1000 Cubic Ft.	Per 1000 Cubic Ft.	Per 1000 Cubic Ft.	Per 1000 Cubic Ft.
YEAR 1883.						
Coal	17 65d.	17·11d.	0·54d.	18·43d.	0 78d.	..
Less residuals	11·25	12·60	1·35	10·96	0·29	..
Net coal	6·40	4·51	1·89	7·47	1·07	..
All working expenses (except rates)	14·23	13·09	1 14	13 61	..	1·62d.
Total net coal and working expenses	20·63	17 60	3·03	20·08	..	0 55
Rates	1·81	1·49	0·32	1·84	..	0 47
	22·44	19·09	3·35	21·42	..	1·02
YEAR 1898.						
Coal	14·24	13·39	0 85	14·62	0·38	..
Less residuals	8 31	9·08	0·77	7·22	1·09	..
Net coal	5·93	4·31	1·62	7·40	1·47	..
All working expenses (except rates)	13 33	12·43	0 90	11·61	..	1·72
Total net coal and working expenses	19·26	16·74	2·52	19·01	..	0·25
Rates	2·51	1·47	1·04	1·42	..	1·09
	21·77	18·21	3·56	20·43	..	1·34
Reduction effected during above period in net coal and working expenses	1·37	0·86	..	1·07	..	..
Add for reduction in rates	..	0 02	..	..	..	..
Deduct for increase in rates	0·70	..	..	0·68	..	..
Net reduction	0·67	0·88	..	0·99	..	..

In 1883 our cost of coal was just over ½d. higher than the South Metropolitan Company, and our residuals realized 1·35d. less; therefore our net coal cost was more than the South Metropolitan by 1·89d. The working expenses, excluding rates, were 1·14d. worse than the South Metropolitan, so that our total net coal and working expenses were 3·03d. worse than the South Metropolitan. If you compare the same figures for the year 1898, there is a slight reduction in the unfavourable comparison. The 1·89d. of 1883 is reduced to 1·62d., and the working expenses 1·14d. to 0·9d.; so that the total net working expenses have been reduced from 3·03d. to 2·52d. In the same way the difference between this Company's figures in 1883 and those of the Commercial, 0·55d. has been reduced in 1898 to 0·25d. Therefore the net working of the Company, apart from the charge for capital, has improved to a greater extent than with either of the other Companies. I know the improvement is small; but all the variations are on the right side, so far as we are concerned—the reduction being in our case 1·37d., in the case of the South Metropolitan 0·86d., and in the case of the Commercial 1·07d. The reason I have excluded rates is that that is a charge over which no gas company has any control whatever.

Will you tell the Committee how it is your coal cost you more?—These are two permanent reasons why the cost of coal in the case of this Company will exceed that of the South Metropolitan. One is the important factor of the lighterage of the coal from ships up to the works.

The works at Beckton?—No, Sir. At Beckton, the ships discharge alongside. I am only dealing at present with those at Bow Common and on the canal—Shoreditch, Haggerston, St. Pancras, and Kensal Green. At these four canal stations and Bow Common we carbonize 409,000 tons of coal a year, and in respect of that, as regards our Shoreditch works, we incur a charge of 1s. 9½d. a ton; at Haggerston, the same; St. Pancras, 1s. 10½d.; Kensal Green, 2s. 6½d.; and Bow Common, about 1s. 6d. The average of these charges is just under 2s. a ton, involving a cost of £40,000 a year.

Mr. STEADMAN: You are referring to the lighterage charges?

Witness: Yes; and it includes the canal dues as well, which amount to something like a fourth of that sum. So much for canal stations. At Bromley, we have to lighter the coal—164,000 tons a year—and we pay for that 5d. a ton; at Fulham, a station on the river itself, we carbonize 131,000 tons a year, and we pay 8d. there for lighterage and tolls. At Nine Elms, a station on the river, we carbonize 192,000 tons of coal; and whether it is carried up by barge from the Pool or by our own ships, the average cost is 7d. a ton. Then we have another small station on the river at Pimlico, where we carbonize some 50,000 tons, and the charges amount to 11d. a ton. This station is rather a small and awkward one. The 7d. at Nine Elms is low; and the reason is that it comes by ship. Our total lighterage expenses amount to £56,000 a year, which is equal to 6¾d. per ton on the coal we carbonize.

The CHAIRMAN: Does that include Beckton?

Witness: There are no charges there.

Do you regard 6¾d. as an excessive charge compared with other Companies?—We do our best to keep those charges down.

What we want to know is whether you regard this 6¾d. per ton as an excessive charge for lighterage, and therefore one of the reasons why your cost is more than that of the other Companies?—Yes, it is in excess of the South Metropolitan Company's figures to a large extent.

Do you know what their lighterage costs per ton?—No. I can, however, give the distances they have to lighter their coal on the canal. Against our varying distances of 2 to 10 miles, the extreme distance they have to lighter is just under 3 miles.

The CHAIRMAN: I am afraid that does not help us to any comparison, because I understand this 6¾d. is the actual amount you have to pay, and you are not able to give us the actual figure of the South Metropolitan Company.

Mr. NICOL: I do not think you gave us the total figure of the coal carbonized at Beckton?

Witness: In 1878, it was just over a million tons. Continuing, he said the works are fully employed. They could not do without any of them. A large amount of capital was invested in the works, and to close any of them would be costly.

The CHAIRMAN: A cost which would not be recouped by less lighterage dues?

Witness: That is a point which we have gone into again and again. The liquidation of the capital outlay would be so large as to go a long way to doing away with any advantage resulting.

Mr. NICOL: Then in spite of the electric light these works are carbonizing to their full capacity?

Witness: No. During the past few years we have not worked Beckton certainly to the full. We could have sent out in the winter of last year 20 or 30 million cubic feet more per day than we did.

The CHAIRMAN: Have you any other point besides the lighterage?

Witness: I will just refer to one which Mr. Haward referred to, and that was the effect of the abolition of the coal dues. He said that the amount of saving, effected by the Gas Companies by the abolition of coal dues was £145,000 a year. Unfortunately that is not so. In 1888-9, just before the abolition, we were paying 11s. 2d. for our coal. In the year 1890 we paid 12s.; and in the years 1891-2-3 we were paying 12s. 7d. Although the prices had gone down, we were then paying fully 6d. per ton more than we were before the abolition.

Mr. STEADMAN: How do you account for that?

Witness: I cannot account for it. I suppose the coal owners got something. We know since 1889 that wages have increased, both down here and up at the pits; so that some has gone to the workmen. But unfortunately nothing has come to us.

The CHAIRMAN: But that is a fact that would affect all?

Witness: Oh, yes! Gas Companies certainly were not benefited by the abolition of coal dues. Another question is that of enrichment. The Board of Trade appoint certain Referees, who decide where and how the gas supplied to London should be tested; and part of their duty is to prescribe certain testing stations, and the apparatus for testing the illuminating power, purity, and pressure. The Companies have to provide these testing places, and to maintain them. The Referees have applied for our district 15 testing stations; for the South Metropolitan, 6; and I think in the Commercial Company they have 2. The latter Company is immaterial. Their district is close, and I have no doubt they have a sufficient number. The area of The Gaslight and Coke Company's district is 67 square miles; so that there is one testing station for every 4½ square miles. The area of the South Metropolitan Company is 52 square miles; so that they have one testing place for every 8½ square miles. We have 11 manufacturing stations for 15 testing stations; the South Metropolitan 6 manufacturing stations and only 6 testing stations. Then in this Company's district the testing places are at distances from the manufacturing stations ranging from ½ to 10½ miles. In the South Metropolitan district, the corresponding distances range from ½ to 3½ miles. It is a well-known fact that gas does lose some of its enriching

power—and I think Mr. Hunt and Mr. Livesey admitted it—at some point in its travelling through the mains. There may be differences as to when the loss is incurred; but I think all gas engineers agree that there is a loss, and that loss we have to bear in mind when sending the gas from the works.

Then, according to that, a few testing stations would be worse than many, because the gas would have to travel further?—If the few testing stations were greater distances from the works than the many; but in this case it is just the reverse. The Company with the few testing stations have those testing stations much nearer to their works than the Company with many testing stations. I will give you the figures. The South Metropolitan Company have their stations—one two miles from the works, one one mile, one 1⅔ miles, two others under a mile, and one only is just over three miles.

You have given us those figures when you say the testing stations vary in the South Metropolitan area between ½ and 3½ miles?—Yes; but I thought you were under the impression that few testing stations would be more disadvantageous to the Company than many.

Certainly, I should say so, if they were placed in distant positions. Now you say they were not so—that, although you have many, they are still more inconvenient owing to their position?—Yes; and bear in mind the more testing stations you have the less likelihood there is of a stream of gas passing untested. If one Company has 6 and another 15, I think the odds are in favour of the 15 station Company being more rigidly tested than the 6-station Company.

You maintain you are kept up to the mark?—We are kept up to the mark, and we have no complaint to make of that; but we do complain when you come to compare, as we are comparing to-day, the cost of making gas by two Companies, unless you are sure you are comparing precisely the same things. The stations are so placed as to necessitate sending out our gas of higher illuminating power, proportionately, than that sent out by the South Metropolitan.

We should like to know the average distances in your area of the testing stations from your works?—I can have that worked out.

Mr. Lowles: I suppose that the gas examiners fix the stations so as to intersect the mains rather than to be near your works?

Witness: Yes.

Mr. Nicol: Your argument is that the further the testing station is away from the works the more expensive it is for the Company to pass the examination of the examiner in reference to the 16-candle power?

Witness: Yes. We have to send out very much richer gas if we have to send it 10 miles than if we had to send it 2 miles.

Speaking generally, you say your stations are further on average from your works than the South Metropolitan testing-stations?—Yes.

Mr. Lowles: For that reason the gas you manufacture when it leaves the works is of a higher quality, and that would have an effect on the price?

Witness: Yes.

It would cost you more to pass the test?—Yes.

The Chairman: Could you not make it clear by telling the Committee what the actual distances are from the works to the testing stations?

Witness: I have them all here. We have five testing places attached to Beckton; and the distances are respectively 7 miles 700 yards, 7 miles 1000 yards, 8 miles 1000 yards, 8 miles 1500 yards, and then, in one extreme case, 10 miles 800 yards from the works. The greatest distance the South Metropolitan Company have is the testing station attached to the East Greenwich works—3 miles and 200 or 300 yards. Then one is distant 1 mile 990 yards, one 1 mile 880 yards, one 1 mile 660 yards, one 1100 yards, one 1600 yards, and one 3 miles 200 yards. I am very sorry to impress it; but it is an important point.

The explanation entirely depends on the situation of your testing stations?—Yes. I find the average in the case of the South Metropolitan Company is 1 mile 2 furlongs, and in our case 4 miles. The largest bulk of gas has to come the longest way.

That is very important. At what do you appraise this disability?—It is very difficult to fix the amount. I do not like to assess the value of the inferior gas sent out by our neighbours.

Mr. Nicol: Was it in consequence of this disability that you introduced carburetted water gas?

Witness: Yes. We can enrich our gas that way more cheaply than we can with cannel. Enriching is a costly thing. Mr. Livesey says that one extra candle means 2d. per 1000 cubic feet.

Mr. Cohen: You do not like to assess what the cost of this inferior situation to you is, because you do not wish to speak as to the quality of the gas supplied by other Companies?

Witness: Yes.

Could you say what it would cost each to supply the same quality of gas assuming that both Companies gave the same quality?—I should say that the disability we labour under is something under 1d. per 1000 cubic feet. I will not overstate the figure.

You mean to say that, taking the same quality of gas, by this situation, you would be affected to the extent of, perhaps, 1d. per 1000 cubic feet of gas supplied?—Yes; but when you come to assess values of this kind, you are dealing with matters upon which you would not get two gas engineers to agree. They certainly would not agree as to a specific amount. The London County Council have been taking a lot of tests with a portable photometer; but I see that they themselves cannot ask for the adoption of that instrument by the Companies without further legislative powers. They have been testing our gas and that of the South Metropolitan Company; and they find that in some of the outlying districts the illuminating power of our gas is 15·7 candles, and in the case of the South Metropolitan Company it is 14·6 candles. These are not my own figures, but those of the London County Council; but if they are reliable so far as the outlying districts go, there is a difference of 1 candle between us.

Mr. Lowles: In your favour?

Witness: Yes. If these figures are right our gas is better than theirs.

The Chairman: Is that all you have to say as to coal and enrichment and dues?

Witness: Yes.

Then pass on to the question of residuals?—Mr. Haward gave a statement of the returns of coke of The Gaslight and Coke Company and the South Metropolitan Company. He does not give the returns of the Commercial Company. The principal mistake he makes is this; He calculates his figures upon what he calls the coke per ton of coal. He gives it per 1000 cubic feet of gas.

It is not clear whether the figures are per ton of coke?—They are per ton of coal used; but he has included in the tonnage the oil and spirit used. We use oil and spirit for enriching purposes; and according to the Board of Trade Auditor's requisitions, all these figures are dealt with as coal. They are reduced to the equivalent in tons of coal; and Mr. Haward overlooked this fact. We do not get coke from the oil and spirit. The correct way to deal with the figures, therefore, is to take out the tonnage of coal pure and simple, and to calculate your revenue as to coke on that.

Mr. Cohen: That will affect one Company as well as another.

Witness: Yes; but we use a larger proportion of enriching materials.

The Chairman: In Mr. Haward's table, for the year 1891, the statement, I understand, is that the price you get for coke per ton is 5s. 2·61d.

Witness: Yes.

Is that the price you get per ton of coal?—No. It is the proportion of the ton of coke which we get per ton of coal. For every ton of coal we use, we get about half-a-ton of coke; and that half-a-ton is valued at 5s. 2·61d.

This, then, is the product of a ton of coal in coke.—Yes.

Is the 5s. 2·61d. the price of a ton of coke got out of a ton of coal?—The proportion.

How does the addition of the oil interfere with, or in any way affect, the amount of coke you get out of a ton of coal?—In no way. But if you add to your weight of coal something else (the weight of oil), then you get the wrong price. You get a ton of coal *plus* something else, which something else gives no coke.

You say that Mr. Haward's ton included something besides coal?—Yes.

Then you would have got more than 5s. 2·61d., if you had a full ton of coal?—Yes.

Mr. Nicol: What do you say it would have been?

Witness: It would be about the same figure in that year, because there was very little oil used.

Mr. Cohen: Before you impeach these figures of Mr. Haward, it is right to know to what extent they are incorrect. You say the figure for 1891 is correct?

Witness: Yes; but so far as I can see that is the only one that is right.

I do not know to what extent his figures are faulty for the purpose of comparison. These figures treat the South Metropolitan Company in the same way as your Company?—Yes.

But you have told us that you use oil?—Yes.

The Chairman: Your assertion is that the actual sum Mr. Haward gave as the amount of coke is too little in comparison with a ton of coal; and you say that if you had used the full ton of coal without oil you would have got more?

Witness: Yes.

Therefore, you compare with the price the South Metropolitan Company say they have got out of a ton of coal?—Yes.

Your figures are under those of the South Metropolitan Company?—Yes.

Witness here put in the following table:—

Amount Received for Residuals, per Ton of Coal, by Each of the Three Metropolitan Gas Companies (as now Constituted), 1876-1898.

Year.	The Gaslight and Coke Company.	South Metropolitan Company.	Commercial Company.	Total of the Metropolitan Companies.
	s. d.	s. d.	s. d.	s. d.
1876 . . .	10 8·79	10 4·68	9 6·60	10 6·88
1877 . . .	9 6·23	9 9·69	8 8·80	9 6·16
1878 . . .	8 6·71	9 2·18	8 7·28	8 8·23
1879 . . .	8 3·86	8 10·54	8 5·68	8 5·30
1880 . . .	9 7 37	9 1·97	10 0·95	9 6·71
1881 . . .	9 8·88	10 5·55	10 4·59	9 11·32
1882 . . .	8 8·84	10 2·58	9 6·86	9 1·38
1883 . . .	9 0·88	9 6·13	8 8·78	9 1·68
1884 . . .	9 0·19	9 6·18	9 1·61	9 1·60
1885 . . .	7 4·04	7 5·70	8 4·44	7 5·39
1886 . . .	6 5·21	6 7·62	7 6·17	6 6·73
1887 . . .	7 0·27	6 8·10	7 4·33	6 11·64
1888 . . .	7 10·56	7 9·59	8 1·40	7 10·56
1889 . . .	8 8·34	8 2·77	8 7·31	8 7·01
1890 . . .	9 2·66	9 5·17	10 0·30	9 3·95
1891 . . .	8 10·79	8 6·68	8 9·39	8 9·71
1892 . . .	7 4·94	8 0·08	7 0·49	7 6·36
1893 . . .	8 0·55	8 7·16	9 0·83	8 3·18
1894 . . .	8 10·53	9 3·04	9 3·89	9 0·13
1895 . . .	7 11·63	7 9·31	7 7·08	7 10·66
1896 . . .	6 7·81	6 9·78	6 3·73	6 8·04
1897 . . .	6 0·42	6 0·85	5 9·04	6 0·29
1898 . . .	7 3·69	7 4·03	7 5·97	7 3·93

Witness: You will find in this table that, although the difference was against us as regards coal in 1897, our residuals in 1892 came to 7s. 4·94d.; while those of the South Metropolitan Company were 8s. 0·08d., and the Commercial Company 7s. 0·49d. In 1898, the figures for our Company were 7s. 3·69d., the South Metropolitan Company 7s. 4·03d., and the Commercial Company 7s. 5·97d. So that, taking them altogether, the figures of the three Companies run very closely indeed.

What is the meaning of the last column "Total of the Metropolitan Companies"?—That is the average of the whole.

It shows you are below the average, the other two above it?—Yes.

You admit that?—Yes; and the reason why, I will explain. In regard to the one item coke, the principal cause is the low price obtainable at Beckton. Beckton is a station right away from our area of supply, and away from London; and the whole of the coke has to be sold in what you may call a wholesale manner. We have to sell either to coke merchants, to cement manufacturers, or to exporters. The difference between the amount realized per ton of coke at Beckton and at in-town stations in 1898, was 2s. 2d. per ton. Our position in this regard was exceedingly bad last year, because the in-town stations with local trade were able to take full advantage of the prices of coke consequent upon the South Wales coal strike;

whereas at Beckton, where coke has to be sold by contracts entered into for a year in advance, it was sold at a rate which had been fixed on before the high prices came in. At all the stations except Beckton—and I may also say at Bromley, where the condition of things has been almost as bad, there being only Bow Creek to take away coke—the sum realized has been 11s. 3d. per ton for coke; but at Beckton and Bromley it only realized 9s. 9d.

Mr. Lowles: Even if you had Beckton in the centre of London, you would have to sell wholesale?

Witness: Yes; but you must bear in mind that the coke could be sold cheaper by the purchasers, because they would not have to send such a distance for it. As to the mode of dealing with coke, I may say that 2s. a ton at Beckton and Bromley compared with our other stations means 0·7d. per 1000 cubic feet of gas.

The Chairman: Is that the loss you wish to put on in regard to the coke of your manufacture?

Witness: I am pointing out a reduced revenue of £60,000 a year, and dividing it over the total value of the gas sold.

How do you get at the £60,000?—We know what money we realize at this station for coke, and what we realize at other stations. We know at other stations it is 11s. 3d. per ton, and at this 9s. 1d.; and that the difference was £60,000 last year. One penny per 1000 cubic feet makes a difference of £80,000 a year. We find that the £60,000 is 0·7d. per 1000 cubic feet on the whole of the gas made.

Would it not pay you to take your coke to other stations for the purpose of sale?—No; we have tried that. Coke is brittle and friable; and it breaks. It will not bear double handling.

Mr. Cohen: It costs something to transport it?

Witness: Yes; and in addition to that, we break it and spoil the value. I may say that, in regard to the lighterage of coke, Mr. Livesey said that the South Metropolitan Company did their own lighterage, and saved a lot of money by it. The principle we adopt in our Company is this—that so long as we are fairly treated by the various tradesmen with whom we have to do business, we will never interfere with any trade. We will not go in for owning our own barges or our own tugs, so long as we can get a fair price from other people. The only trade the Company ever interfered with was the tar and liquor trade; and that was because the prices were being forced down very low, and we were bound to take up the manufacture ourselves. Beyond that, we have taken up the work of no outside traders who are able to do their business better than we can.

Mr. Steadman: Mr. Livesey told us that his Company saved 50 per cent. by doing their own lighterage. Well, the saving of this 50 per cent. enables them to sell their gas at a less price than you can. Do not you think that, apart from interfering with the businesses of other traders, it would be to the interest of the consumers of your Company to have your own craft. You would save more than the South Metropolitan Company?

Witness: I read Mr. Livesey's evidence the other day; and I noticed that he was asked whether, in his calculation, he included wear and tear of barges. His answer was very instructive. He said something about what happened to him when he was 16 years of age. Whether that interested the Committee or not, I cannot say; but, at any rate, he did not tell them anything in reply to their question as to the wear and tear of his barges. I may point out that another reason why we have not gone into this matter is that all the in-town stations, to which the cartage of coal is very expensive, are almost closed for eight months in the year—transferring the work to Beckton. If, then, we had barges of our own to do the whole of the work of lightering during the winter, we should have them idle in summer. We have no power to let them out, so that we should have a large number of barges and tugs lying idle during part of the year. That is not the case with the ordinary bargeman, who has other sources of trade.

The Chairman: Then you say you are doing the best for your Company, as well as for the public, in not doing your own lighterage?

Witness: Yes. Then as to wages. Mr. Haward has given the wages for us at 3s. 5d.; and at 2s. 2d. for the South Metropolitan Company. We paid in 1898—one year later than Mr. Haward dealt with—3s. 7d. per ton, the South Metropolitan paid 2s. 3d., *plus* something, and the Commercial 3s. 7½d. It would therefore appear that both the Companies in the north of London were paying the same rate for work done; whereas the South Metropolitan Company were getting this work done for 2s. 3d. This is owing possibly to the fact that the South Metropolitan Company employ a large number of mechanical stokers. Well, as bearing upon this, it is interesting to look at some other figures. I can take out the working of another Company of which Mr. Livesey is Chairman—the Crystal Palace Gas Company. The wages there I find are 3s. 7d.—the same as our own. Therefore, it would appear, after all is said and done, that there is not so very wide a discrepancy in the item of wages as would seem on the face of it between ourselves and other Companies. Mr. Livesey in connection with the Crystal Palace Company cannot do better than we can.

Mr. Nicol: Do you think that a fair comparison to make, between yourselves and the Crystal Palace Company?

Witness: I take that Company because, after all, it is the different conditions affecting the separate Companies which rule these matters. It is my object to point out that two Gas Companies, presided over by the same Chairman, show different figures for wages—in the one instance the figure being 2s. 3d., and in the other 3s. 7d.

On being asked whether he thought it was fairer for purposes of comparison to take the Crystal Palace Company as against his than the South Metropolitan Company, witness was understood to reply in the affirmative. Asked if he had any reason for this opinion, he said he presumed that the Crystal Palace Company had not the large number of mechanical stokers which the South Metropolitan Company possessed.

The Chairman: You admit that mechanical stokers do lower wages?

Witness: Yes; and we should have introduced them to a larger extent than we have done, if it had not been for two things. In the first place, it would have involved enormously increased capital outlay, and we are heavily handicapped with capital. Then, again, a large number of our retort-houses are old-fashioned; and to adapt them to mechanical stoking would involve a large outlay, not only in capital, but in revenue too. We were hard pressed under both heads; and that is the reason why we have abstained from going in for these stokers. Last year, when Mr. Livesey brought up a further increase in the rate of wages payable to stokers, Mr. Jones, of the Commercial Company, and others representing our own Company, said: "If wages go up in this way, no doubt we must make up our minds to spend more money in apparatus." A large proportion of the money we are asking Parliament for this year is to fit up our retort-houses at Beckton with stoking machinery, and also to fit some of it up at other stations.

Mr. Steadman: There is no difference between the rates of wages paid by your Company and those paid by the South Metropolitan Company, is there?

Witness: I do not know. In some houses they have a two-shift system instead of a three.

But they pay the men extra?—Yes; but whether or not it is proportionate, I cannot say. In addition to our wages, we provide for the payment of pensions to our men. We get a lot of old and infirm workmen; and when a man arrives at the age of 60 or 65——

The Chairman: "Or?"

Witness: Yes, because it is compulsory at 65—we grant him a pension of one-third of his wages, provided he has been with us for 25 years, and has a good record. Recent legislation makes this compulsory retirement more desirable than ever.

What account do you charge the pensions to?—Annuities.

Do you contend that the annuities—the pensions you pay—go to increase your cost of gas by ½d. per 1000 cubic feet?—No; that is due partly to annuities to officers.

But it all has to go to the cost of gas?—Yes.

You pay pensions to workmen of all kinds, and they stand you in ½d. on the cost per 1000 cubic feet of gas?—Yes. I may say the workmen greatly appreciate the benefit of the scheme; and I hope it will have the effect of keeping them in better order.

Mr. Nicol: What is the average wage of a stoker in full work?

Witness: About 35s. per week.

So that his annuity at 65 would work out at 11s. or 12s.?—Yes.

Your men do not enjoy the profit-sharing scheme?—No; but I think this will have the same effect.

What proportion of your men are in a position to earn an annuity?—All the regular hands.

The men under the condition of 25 years service. What proportion of your men remain with you so long?—A good proportion of them. But you must bear in mind that gas work is rather hard, and that some of the men drop out of it.

Do you mean that they die?—No. I mean that the work becomes a little hard, and they seek other employment. If a man, before reaching the pension age, becomes ill and unfit for work, the Directors accord him a pension on the same basis, but reduced in scale according to his number of years' service or age.

The Chairman: Do most of your men belong to Friendly Societies?

Witness: I do not know.

You do not interfere with them in regard to that?—No; and, of course, nowadays it does not do to ask too many questions.

Mr. Nicol: They earn this on their merits. You do not take into account whether they belong to any Friendly Society?

Witness: No. We say that if a man has served the Company well for a certain number of years, he is entitled to a pension. It is not fair to take into account anything else.

You do not mention this circumstance in making your contract with them?—Oh, no.

The workmen likely to get into your employ would know that this was one of the advantages of your service, I suppose?—Yes, they would get to know it no doubt; but we take no steps to advertise it.

Mr. Lowles: How long has your pension scheme been in operation?

Witness: About four years.

In further examination, witness said that the amount which The Gaslight and Coke Company paid in rates, in excess of the South Metropolitan Company, was 1d. per 1000—the respective figures being 2½d. and 1½d.; and he thought there was no chance of their getting any abatement so long as the present principle of rating public companies continued. On one occasion, however, the Company did spend several thousands on law, and obtained a very appreciable reduction in the assessment; and he was glad to say it had the effect of stopping, for the next quinquennial period, any attempt to enhance the assessment. He went on to state that at Beckton they had had to spend £7000 this year in making provision for the disposal of their sewage; and that would cost them some £2000 a year to maintain. Coming to the important question of capital, he asked the Committee to disregard some of Mr. Haward's figures. Mr. Haward made the gross amount of capital expenditure by the Gaslight Company £2,456,000 for the years 1890-8; but he credited nothing for amounts written off capital from time to time for depreciation of plant, &c. These credits amounted to £164,000; and represented a sum of £57 per million cubic feet of gas sold. Witness could not understand how Mr. Haward omitted these credits, because in his statements he set them out in detail. This reduced his figure of £854 (the rate per additional million feet of gas sold in 1890-8) by £57; making it £799. A similar correction for the South Metropolitan Company made their corresponding figure £288, against £296 stated by Mr. Haward; while, with the Commercial Company, there was practically no alteration. Witness went on to refer to a table (top of p. 1756) giving the capital expended per million cubic feet increase in gas sold by each of the Metropolitan Companies (as now constituted) in the years 1876 to 1898. Mr. Haward had taken a group of years—1890-98—and found, correctly, that the expenditure incurred during that period by the Gaslight Company was £799; and this he compared with the corresponding figure of £288 of the South Metropolitan Company, and of £415 of the Commercial. But Mr. Haward had not taken into account that, in the preceding period of seven years—1882-89—the Gaslight Company's expenditure per million was only £98, whereas with the South Metropolitan Company it was £385, and with the Commercial £318. Then going back further, to the period 1876 to 1881, the Gaslight figure was £487, the South Metropolitan £399, and the Commercial £381. It was not fair to this or any other Company to take out a number of years during which, by reason of bad business, or other causes, the Company's expenditure was large in proportion to their increase of business, without taking into account, also, that in a previous group of years the conditions were precisely the reverse. There was no other figure anywhere such as this £98. He claimed that in dealing with the expenditure of the Company's

Period.	Percentage of Increase in Gas Sold for the Period.	Capital Expended	Capital Expended per Million of Increase.
GASLIGHT AND COKE.			
1876 to 1881	37·15	£1,805,994	£487
1882 to 1889	32·26	433,640	98
1890 to 1898	15·86	2,293,981	799
1876 to 1898	110·16	£4,533,615	£412
SOUTH METROPOLITAN.			
1876 to 1881	41·61	£450,793	£399
1882 to 1889	46·85	693,147	385
1890 to 1898	64·16	1,044,811	283
1876 to 1898	241·45	£2,188,751	£334
COMMERCIAL.			
1876 to 1881	41·10	£165,962	£381
1882 to 1889	26·73	127,118	318
1890 to 1898	26·71	209,900	415
1876 to 1898	126·58	£502,980	£375

capital, they should take the average of the whole period from 1876 (when the Gaslight Company were last before Parliament) to 1898, which gave the figure of £412 for the Gaslight Company, £334 for the South Metropolitan, and £375 for the Commercial. The expenditure during 1890-98 of £799 was caused first by those bad years in which there was an absolute decrease in the Company's business; and, second, by the large expenditure which they had to incur in providing stoves and fittings for automatic meter consumers. In ordinary circumstances, the expenditure of gas companies for works was about £300 per million feet sold, or, including distribution expenses, any figure up to £400 per million sold; but with consumers by automatic meters the expenditure per million sold was increased by another £300. During the period 1890-98, the Gaslight Company had to incur the whole of this extra expenditure; and it came at a time when they were having decreases in the quantity sold. It might be argued that they had no right, seeing that they had a reduction of business, to spend money to enlarge their works. But gas companies were bound under statute to meet every demand made on them; and they could not speculate that because there was a mild winter this year there would be a mild winter next year, or that because they had two mild winters they would have another next year. Their calculations had regard, not so much to the increase of business, as to the increase in the number of consumers; and the number of consumers had been rapidly increasing from year to year, despite the temporary reduction in their business. From 1883 to 1898, the consumers had increased by 136,762.

Mr. NICOL: How many of these were in connection with the automatic meter system?

Witness: About 90,000. Seeing that we had this large increase, we were bound to make provision for the possible requirements of these new consumers; and therefore we have had, during these nine years, to go on spending money. There was another reason, too. From 1876 to 1881 we spent £1,805,994; and from 1882 to 1889, only a very small amount—£433,640. We were too economical in those periods.

Which period was it you took advantage of your reserve fund?—The period 1890-98. We found in 1890-91 we had not made sufficient provision for the increase of business; and on one or two occasions we ran too short. The Directors said: This will not do; we must be in a position to take up the full public demand. Therefore during the period succeeding, 1890-98, we have increased the capital expenditure on our works; and, given an ordinary winter, we do not anticipate we shall have an excess over the requirements of the Company. I want the Committee to realize that the figure of 1890-98, £799, must be averaged in order to arrive at any fair comparison with the corresponding figures of the Commercial or South Metropolitan. This year in our Bill we asked for £3,500,000, to last us twelve years. That was cut down to £2,500,000, which we anticipate will last us for eight years.

The CHAIRMAN: You say that the comparison should be between £412 for your Company, £334 for the South Metropolitan, and £375 for the Commercial?

Witness: Yes. Continuing, he said they applied to Parliament this year on the basis of £392 per million cubic feet.

Even according to these statements, the amount which you acknowledge, £412, since 1876 has been above the average, or the estimated average?—Yes.

Have you any reason to adduce as to why your amount has been above the average, which you admit?—Yes, and that is the key of the whole of our position—the increase of business. Our increase of business during this period, 1898 over 1876, has been at the rate of 110 per cent.; with the South Metropolitan Company, 241 per cent.; and with the Commercial, 126 per cent. Gas companies, like other business people, can meet their requirements for new works at a lower cost now than formerly. Mr. Livesey explained to you the other day that whereas they used to put up small gasholders, large holders are now built at a very much lower proportionate cost. The same applies to all other parts of a gas company's plant; and the result is that the more business a gas company can get, the larger the proportion of these modern and less costly works they have at their disposal. For instance, to put the case of these two Companies, the South Metropolitan in the 23 years, with their increase of 241 per cent., have now five-sevenths of their whole works constructed on the more modern system, and with cheaper capital. This Company, with an increase of 110 per cent., have only half their plant constructed on the modern and cheaper style, and with cheaper capital. I want to urge this point before the Committee, because, after all, one of the chief answers on which The Gaslight and Coke Company rely in dealing with this capital question, is the relation which the increase of business bears to capital expenditure. The witness went on to refer in detail to the following explanatory statement of the differences between The Gaslight and Coke Company's capital expenditure and that of the South Metropolitan and Commercial Companies (dealing with the Companies as they are now constituted):—

	The Gaslight and Coke Company.			South Metropolitan Company.			Commercial Company.		
	Millions.			Millions.			Millions.		
Quantity of gas sold in the year 1875	9,981	..	..	2716	..	..	1060	..	..
Capital expended on Dec. 31, 1875	..	£8,149,000	..	..	£1,782,000	..	..	£528,638	..
Capital expended on Dec. 31, 1875, per million cubic feet of gas sold	..	..	£816	..	..	£656	..	..	£499
Increase in the sale of gas, 1876 to 1898 inclusive	10,996	..	..	6557	..	..	1341	..	..
Capital expenditure between Dec. 31, 1875, and Dec. 31, 1898	..	4,534,000	..	..	2,189,000	..	..	502,980	..
Capital expenditure between Dec. 31, 1875, and Dec. 31, 1898, per million cubic feet increase	..	..	412	..	..	334	..	..	375
Total quantity of gas sold in 1898	20,977	..	..	9273	..	..	2401	..	..
Total capital expended on Dec. 31, 1898	..	£12,683,000	..	..	£3,971,000	..	..	£1,031,618	..
Total capital expended on Dec. 31, 1898, per million cubic feet of gas sold	..	..	£604	..	..	£428	..	..	£430
Deduct in respect of the larger proportion of the maximum day's delivery of gas (£400,000) and of the cost of the transfer of manufacture of gas from London to Beckton (£1,500,000)	..	1,900,000							
Per million cubic feet of gas sold	..	..	90						
		£10,783,000							
			£514						
Hypothetical further increase in gas sales to bring up the figure to the level of the South Metropolitan Company—viz., 241 per cent.	13,109	..	..						
Hypothetical capital expenditure, on the basis of the Company's net capital expenditure, 1876 to 1898, per million cubic feet of increased capacity	..	4,588,000	..						
		..	350						
Corrected totals and averages—Gas sold	34,086								
Capital	..	£15,371,000							
Capital per million	..	..	£451	Against the South Metropolitan figure of		£428	Against the Commercial figure of		£430
	£451 per million is equal to 9s. per 1000 cubic feet.			£428 per million is equal to 8s. 7d. per 1000 cubic feet.			£430 per million is equal to 8s. 7d. per 1000 cubic feet.		

This table shows that the capital expended in 1875 per million cubic feet of gas sold was: Gaslight and Coke Company, £816; South Metropolitan, £656; Commercial, £499. The Gaslight and Coke Company's increase in sale from 1875 to 1898 gave a capital expenditure in that period of 4½ millions, or £412 per million of increase; the corresponding figures for the South Metropolitan Company being £334, and for the Commercial Company £375. If the Company had what he called a hypothetical further increase of 13,109 million cubic feet, to bring up the percentage of The Gaslight and Coke Company to that of the South Metropolitan, and constructed the necessary further works, the cost would be £350 per million, or £4,588,000. This would make the total gas sold 34,086 million cubic feet, with a total expenditure of £15,371,000,

or £451 per million, against a figure of £604 per million cubic feet of gas sold in respect of the total capital expenditure to December, 1898. This figure of £451 would also compare with the £428 of the South Metropolitan, and the £430 of the Commercial. The outlay on this hypothetical further increase would be made at such a very low rate that it would reduce the Gaslight Company's total average to very near the South Metropolitan figure. The amount of £350 per million, witness added, was no guess figure, but the one adopted in their calculations before Parliament.

The CHAIRMAN: If you had been in the same position, you say, as the South Metropolitan, with regard to increase, your figure would have been £451 per million, instead of £604?

Witness: That is our case to-day before you.

Mr. COHEN: That is one of the principal reasons you urge for the differences—the discrepancy—in the rate of increase?

Witness: That accounts to a large extent for the 3½d. per 1000 cubic feet which we have to charge our consumers—capital charge.

The CHAIRMAN: Have you any other point to urge as to capital?

Witness: Yes. I will deal with the £1,500,000 which was the cost of transferring our chief station to Beckton. It has been urged over and over again before this Committee that in going to Beckton and transferring our manufacturing plant there, we only did what the South Metropolitan and the Commercial Companies did. There is a fallacy there. The Gaslight and Coke Company are the only Company who have been called on by Parliament to remove their manufacture from the heart of London to some place in the suburbs. Other Companies, it is true, have built additional works. This has been done at East Greenwich and at Poplar; but those were additional works to take up additional business. In our case, however, we had to move from Westminster, Curtain Road, Brick Lane, Goswell Road, and Blackfriars; and the capital so spent remains to-day. The Government Auditor has limited the amount to be written off in consequence of these removals; and it will take some years before the amount still standing to the debit of the four stations is liquidated. We have written off some £200,000 or £300,000. While the Government Auditors wished to see the capital outlay liquidated, they did not want the consumers to be burdened with a further charge. They fixed the sum to be paid—£6000 a year—and at that rate it will be many years before the amount is liquidated.

When you gave up using particular stations, what did you do with them?—The Westminster station is still in use to this extent: We had to pull down all the retort-houses and purifiers, but we erected two large gasholders. The whole cost incurred is charged to revenue.

Did you get nothing in the way of sale or otherwise?—No; we used the whole of the land for gasholders and the Company's offices. We have nothing to show for our capital except the value of the land. At Blackfriars, the works were demolished; and we sold the land. De Keyser's Hotel now occupies the site. We received £175,000 for the land. At Goswell Road, we retained the land, and we have offices there. The land we hold at the present time. We do not like to sell land in London, because we never know what may happen. A gas company ought never to sell land. Curtain Road was a very small place. There we sold; and it is written off. It is difficult to criticize the reason for selecting the sites in the old days. We have no right to assume that those who preceded us in the management of the affairs of the Company were less wise than we are. In 1867, we saw that as we were going on we had no chance with the other Companies, and that if we wanted to sell gas at all cheaply we should have to go to Beckton, where we could secure water carriage for our coal. We went to Beckton in 1870.

Did you state the whole amount of the disused capital on these stations?—To-day it is £375,000.

That is allowing for the amounts written off?—Yes. Between £200,000 and £300,000 has been written off. The expenditure was more because, in addition, there is the value of the substituted plant to be considered. The amount I mention is the sum which stands on our books to-day. Another item in connection with Beckton is this: When we amalgamated with the Imperial Company at Bromley, in 1876, we bought over land with the idea that for this district of supply—the largest in London—the gas would be manufactured there. But when we amalgamated with them, we found that the cost of making gas at Bromley for the district would be 3d. or 4d. more than it would be if made at Beckton. We knew that the Imperial Company had these works; but it was not until after we had amalgamated that we saw the disparity. The amount of disused capital at Bromley is £430,000. They have a dock capable of dealing with four times as much work as is done there, and a large amount of surplus land. They built a very fine bridge over the Lea at Bow Creek, with a view not only of keeping up a connection with London, but of giving a good passage for the carting away of coke. If we had amalgamated a few years earlier, all this expenditure would not have occurred.

Then am I to understand that you have £375,000 of disused capital at your three stations in London, and £430,000 at Bromley (making £805,000 in all) that is at present unremunerative?—Yes. Then in addition to that we had to construct a new road three miles long when we went to Beckton. We had to do this for two reasons—to get traffic into the station, and for the purpose of laying pipes for the conveyance of gas from Beckton to the heart of London. This cost between £30,000 and £40,000. The pipes were 40-inch mains. This, and the bridge over Bow Creek and the pumping-station, involved an expenditure of £360,000. That was for the purpose of bringing gas from Beckton to the district of supply.

Do you put that down as unremunerative capital?—No; but I deal with it as one lump sum in the aggregate cost of removing to Beckton. The same thing applies to the branch railway that the Great Eastern Company constructed for us. In addition to surplus land, it cost us £47,000. The cost of works for dealing with residual products was £260,000. That again was a thing which the other Companies have not gone into. The other Companies have sulphate of ammonia works; but they have not gone in for the manufacture of tar products. The total amount with which I am dealing comes to £1,500,000.

What amount of that do you regard as lost, or not remunerative capital?—I should say the works at the disused stations – £375,000.

And the £430,000 you referred to at Bromley?—Yes; that is disused capital for the present. The others are works established for the Company; and I say that no other Gas Company have had to carry their operations to such a distance from the area of supply.

They are unremunerative works?—Well, but we are comparing our expenditure with corresponding expenditure of other Companies; and I say that before you can arrive at the fair basis of comparison, you must eliminate such items as do not appear in both accounts.

Then you wish us to take this sum of £1,500,000 as the amount of capital which is against you in the circumstances of the case?—Yes.

You have something to say about the works you put up to meet your maximum day's delivery?—Yes, I will put in another table.

Witness then handed in the following table:—

Maximum Day's Delivery of Gas in the District of The Gaslight and Coke Company and in that of the South Metropolitan Gas Company.

Year.	The Gaslight and Coke Company.			South Metropolitan Company.		
	Maximum Delivery.	Proportion of Annual Make.	Per cent. of Annual Make.	Maximum Delivery.	Proportion of Annual Make.	Per cent. of Annual Make.
	Thousands.			Thousands.		
1883 . . .	81,422	1-196th	0·51	..	..	..
1884 . . .	85,148	1-192th	0·52	..	..	..
1885 . . .	95,685	1-178th	0·56	..	..	..
1886 . . .	103,440	1-168th	0·60	28,854	1-186th	0·54
1887 . . .	103,747	1-174th	0·57	27,381	1-206th	0·49
1888 . . .	103,550	1-180th	0·56	30,612	1- 92th	0·51
1889 . . .	115,878	1-167th	0·60	29,333	1-205th	0·49
1890 . . .	125,721	1-159th	0·63	35,077	1-180th	0·56
1891 . . .	128,207	1-161th	0·62	34,758	1-197th	0·51
1892 . . .	116,338	1-175th	0·57	35,824	1-197th	0·51
1893 . . .	114,727	1-170th	0·59	36,672	1-192th	0·52
1894 . . .	105,097	1-185th	0·54	36,920	1-204th	0·49
1895 . . .	110,312	1-187th	0·53	41,938	1-198th	0·51
1896 . . .	119,016	1-180th	0·56	46,706	1-188th	0·53
1897 . . .	121,698	1-184th	0·54	47,552	1-197th	0·51
1898 . . .	119,922	1-187th	0·53	45,224	1-217th	0·46

Witness said this table was very complicated. It showed the maximum consumption of gas in any 24 hours in the case of his Company and the South Metropolitan Company. The test of the capacity of works was the maximum quantity of gas which could be turned out in the course of any 24 hours; and when he said this, he meant not only what could be made in the retort-houses, but taking into account the storage capacity of the works, and the amount they were able to supply to meet extra demands. They, of course, were able to send out more gas than they could make on any one day. As a rule, in all gas companies the proportion of this maximum day's delivery was about 1-200th of the whole annual consumption. That was an uneven figure, as there were 365 days in the year. In the results between themselves and the South Metropolitan Company, there was a great difference. The heaviest day's consumption of his Company bore a larger proportion to the annual consumption than that of the South Metropolitan Company, whose figure for 1898 was 1-217th, while that of his Company was 1-187th. All comparisons were on the quantity of gas sold in the year. When they came to the question of capital expenditure, they had to bear in mind other matters. If the quantity of gas sent out in any 24 hours bore an unduly large proportion to the annual consumption, they had to make as well as store it. They could not go on indefinitely storing it. Then, again, stored gas required to be re-enriched; and for this reason storage alone would not do. They had to make to meet an unusual demand, as well as supply from storage. Everything over 1-200th was greater than the average. He estimated that the cost of extra plant required to meet the maximum day's demand was £400,000. They had sent out 128 million cubic feet as the largest quantity in any one day; and their increase of consumers and of business satisfied them that, if they had had a normal winter last year, instead of sending out 128 millions, they would have had to send out 140 or 150 millions. Of course, they had to provide for this amount. They provided for 140 millions. This was about 1-170th.

The CHAIRMAN: The difference between 1-161st and 1-200th costs you £400,000?

Witness: Yes.

Have you any figures to show the extra capacity the South Metropolitan have established to keep up with your 1-200th?—No; but that Company have not been subject to the same variations that we have. They have only had one exceptional year, and that was in 1896. In our case there have been great variations; the reason being that the supply of the City is different to that on the other side of the water. In the City and West-end, with their streets of shops and warehouses, they must have gas when fogs are prevalent. In an ordinary residential district, it is not so necessary. In the City, you may have an enormous discrepancy between one day's gas supply and another.

That is owing to fogs?—Yes, fogs and darkness.

Mr. NICOL: The electric lighting companies have ousted you?

Witness: Yes; but they have not taken the whole of the City and West-end supply. The electric light is not so useful in foggy weather as gas.

The CHAIRMAN: It is not used in street lamps?

Witness: Yes. It is this increased consumption of gas on extraordinary days that is such a burden to us. In new works we had to put up, we should be guided by the experience of the past.

Mr. NICOL: The South Metropolitan Company are under the same obligation as you are to supply gas in all sorts of weather, are they not?

Witness: Yes; but, as I have said, they have not the City to supply.

The Committee here adjourned.

Friday, June 23.

Mr. JOHN W. FIELD was recalled.

Further examined by the CHAIRMAN, he explained that the reason the lighterage of coal at the Pimlico station of the Company cost 11d., against 7d. at Bromley, was that in the former case the coals were unloaded at the Company's own works at Beckton, and the Company therefore obtained the profit of unloading; whereas at Bromley a contractor did the unloading and received the profit. This approximately accounted for the difference. He went on to summarize the differences dealt with so far as between the South Metropolitan Company and his Company

He claimed that, according to his figures, the difference between the two Companies was only 7·38d. per 1000 cubic feet—taking the average of the charge for 1898. This figure was composed of 0·5d. lighterage, 0·4d. enrichment, 0·7d. residuals, and 0·7d. wages. Then there was a difference of 0·3d. in respect of stoves, which item had not so far been dealt with. The Gaslight Company apparently did not receive quite so much for stove-rentals as the South Metropolitan Company; but, he thought, that was a matter of account, and not of fact, for he did not suppose that the South Metropolitan Company charged more for the hire of their stoves than the Gaslight Company. Sundries—principally distribution charges—totalled 0·1d. These items amounted to 2·7d., or with rates, 1·1d., 3·8d. Then the extra charge in the case of the Gaslight Company in respect of capital was 3·6d., which added to the 3·8d. made 7·4d.; and this balanced practically with the figure of 7·38d.

You wish us to understand that the difference of 7·4d. between your price and that of the South Metropolitan Company is made up under the heads you have now given us?—They are.

How much is your floating capital?—£423,000. The largeness of the sum was accounted for first of all by the fact that they had a larger suspense account in connection with their automatic meter supplies than the South Metropolitan Company. The South Metropolitan Company's figure was £27,000, against £300,000 with the Gaslight Company.

Where have you got the capital from?—It is using for temporary purposes the capital which we raise from time to time by the issue of stock. But we do not deal with this expenditure in the same way as we do, say, the laying of a main.

But do you pay interest on it?—Yes.

You are paying this suspense account off out of revenue?—Yes.

Mr. Cohen: But in the meantime the capital carries interest all the time?—Yes, we all have to pay interest on our floating capital, whether large or small.

The Chairman: What is the distinction between your floating capital and other capital?—It is not fixed capital. You cannot earmark expenditure. In order to carry on the undertaking of the Company, we are obliged first of all to have a certain amount of coals in hand. That has to be provided out of floating capital. The same applies to the manufacture of products, and to stores in hand.

It is your stock-in-trade?—Yes.

Replying to Mr. Lough, as to why the Company's suspense account in respect of automatic consumers should be £300,000, whereas the corresponding figure with the South Metropolitan Company was only £40,000, he said the Gaslight Company spent, as formerly explained, much more on fittings. They got their value for the expenditure, as they put in larger meters, better fittings, and certainly better stoves than the South Metropolitan Company. Further the South Metropolitan Company commenced the system before the Gaslight Company; and therefore they had been able to liquidate their suspense account to a greater extent than the Gaslight Company.

The Chairman: Why will you ever liquidate it while you are a going concern?—Because of the larger number of ninepences we get. We increase the bulk of our consumers by this system, and in this way the ninepences increase at a greater rate.

But you will always require to have a stock of coal on hand?—Yes. We shall never liquidate the floating capital. The South Metropolitan Company were apparently using a little of their reserve fund, which had not been invested, as floating capital. The figure of £423,000 meant that if the Gaslight Company were to wind up their business to-day, sell off their stocks, pay their debts, and get all their accounts in, they would then have £423,000 in hand. This sum was at present supplemented by a loan from their bankers of £450,000.

Sir A. Scoble: If I understand you, you have against this £423,000 of floating capital and £450,000 of loans from your bankers, debts of £900,000 odd?—Yes. These items would grow less, and become balanced by the debts due from customers.

Therefore what you stated at the beginning, that your floating capital was represented by stores and partly by debts due from customers, did not convey the impression I now have, that the £423,000 must represent the stores you have in hand?—Yes.

And that stores are not only the stores affected by the supply of automatic meters, but your coal and other articles?—Yes.

It comes to this, that £423,000 or more really represents the stores account, and this stores account is paid off from revenue from time to time as the stores are taken into use?—Yes. As the stores are used, they cease to form part of the floating capital; and they either become part and parcel of the fixed capital or else they are used for wear and tear purposes and charged to capital.

Mr. Cohen: Apparently you always need a loan. Therefore it is a permanent loan?—As you know, the Money Market has been favourable for borrowers; and seeing that we have been hard-pushed for money, we have had recourse to our bankers to a larger extent than formerly.

Continuously?—Almost continuously. Witness added that now that the Money Market was tighter they thought it better to pay it off.

The Chairman: You maintain it is better business to have a loan at a less rate than you could raise capital at?—Yes. If we were to have no loan from our bankers, at the end of the year it would mean that we should have a large amount of cash in hand at the end of the half year, probably earning 1 per cent.

Mr. Cohen: Is £966,000 about the normal amount due to your bankers?—Yes.

In reply to Mr. Lough, witness gave details of the item, sundry stores £263,000—purification stores £31,000; lime burning £125; general stores (iron, bricks, cement, &c.), £163,000. Every item, he said, had been examined and certified by Sir Robert Giffen, the Official Auditor.

Could you tell us what you pay your bankers for this loan?—Bank-rate.

That is 3 per cent.?—Not always.

But it has been so for a long while. At any rate you have told us it is cheaper to borrow than to raise capital.

Witness replied that, if they compared the rates at which they could raise ordinary shares and debentures with the bank-rate, they would see there was considerable saving.

Further examined, witness referred to the statement of Mr. Haward regarding the transfer of the Company's works to Beckton, that "the effect of the Company's plea is that the high price of gas must be continued in order that their shareholders may continue to pay 12¼ per cent. upon a large sum of capital which is dead and should have been written off long ago." He had explained the cause of this transfer to Beckton, and he should like the Committee to remember what it really meant, and why it was only justice that the consumer should be called upon to pay interest on the capital, part of which was not altogether profit earning. The removal of their works from town surroundings to a suburb in 1870 was really a very great benefit to London.

Mr. Lough: Why is it to go on for ever; 30 years have already passed? Mr. Haward's argument was that it ought to gradually disappear. Our point is that at the end of 30 years the thing should be got out of the accounts?—The answer is that when Parliament gave power to move to Beckton, they did not impose any restriction.

The Chairman: They did not say: You shall have a sinking fund?—No.

Mr. Lough: I do not think that is an answer. Are you not, in the interests of your shareholders, trying to get your undertaking into a solvent state?

Witness was understood to assent.

Continuing, witness alluded to the statement of Mr. Hunt, to the effect that the Gaslight Company had spent a million-and-a-half more money than the South Metropolitan Company would have done under similar circumstances. Mr. Hunt did not, he said, attempt to justify this statement by any evidence. It was an allegation wholly unsupported by what Mr. Hunt said afterwards.

Mr. Cohen: Not merely unsupported, but, in your view, incorrect, I suppose?—Absolutely incorrect. He played the same trick with the figures as I have complained of before. He took a period of ten bad years, and excluded all the good years. That is not the way to give evidence. It is little short of dishonest. Continuing, witness went on to refer to a statement Mr. Hunt put in showing the cost of manufacture in the case of the Gaslight Company and of the South Metropolitan Company. Witness handed in a statement reproducing Mr. Hunt's table, and showing the corrections which he now wished made. After dealing with the items of expenditure, Mr. Hunt deducted in the earlier period, 1888, the amount received for rents and miscellaneous receipts and rental of meters and stoves. What the amount of rental received from meters and stoves had to do with the cost of gas making, witness was at a loss to understand. The object of Mr. Hunt would be apparent if the Committee looked at the 1898 figures. In the interval between 1888 and 1898 the Gaslight Company had abolished meter-rents; and therefore in 1898 no deduction was to be made from the Gaslight Company's cost of gas making in respect of meter-rents. For this reason Mr. Hunt practically increased the Gaslight Company's cost of gas making by ¾d. per 1000 cubic feet. A more dishonest statement, he thought, was never put before the Committee. Witness, in his tables, had eliminated all rentals whatever; they had nothing to do with the subject. He further said the adjusted figures for the three Companies showed a marked difference from the figures of Mr. Hunt.

The Chairman: The result apparently is that between 1888 and 1898 you increased something like 2d., the South Metropolitan Company decreased a little over 1d., and the Commercial Company increased 0·2d.?—Yes. You will find that this Company have improved to a greater extent than either of the other Companies in cost of coal.

Mr. Lough: Did Mr. Hunt make the same deduction in 1898 as in 1888?—Yes; but he had nothing to deduct. The rent of meters has nothing whatever to do with the cost of gas made.

The Chairman: Why do you quarrel with the figures of 1888, before you had done away with the meter-rents?—I only quarrel with them because Mr. Hunt uses them in his evidence as a comparison between 1888 and 1898. I should not quarrel with that if he did not use the year 1888 as a basis of comparison with 1898. I do not quarrel with them so far as they relate to 1888 only; but I do clearly quarrel when they are compared with another year.

Mr. Lough: Is it not the sole point of Mr. Hunt's original table that, whereas in 1888 there was a difference in favour of the South Metropolitan Company of 3·74d. per 1000 feet, by 1898 the figure had increased to 8·32d.?—Yes.

Do I understand you merely assail that to the extent of only 0·30d. or 0·40d. in connection with this intricate meter question?—No, I have not dealt with the interest and dividend charges.

The Chairman: Your contention is surely that you allow the figures of 1888 to stand as Mr. Hunt put them; but that you would add to your figure of 1898 some figure (which I do not know at present) in addition to the present 0·52d. which he puts down as your meter-rent. That would somewhat reduce the 34·01d., and would be the figure, if you had still charged meter-rents, which ought to be used in comparison with the South Metropolitan Company's 25·69d.?—Yes.

You cannot give the Committee the figure?—Yes it would be 0·75d. That would bring it down to 33·25d.

Then now you say that 33·75d. would be a fair comparison with the 25·69d. of the South Metropolitan Company?—Yes.

Mr. Lowles: I think what Mr. Field says is right—for the purpose of comparing the cost of manufacture, the receipts from meter-rents ought to be eliminated.

In reply to Mr. Lough, witness agreed that the table showed that, whereas the South Metropolitan Company were 3⅔d. better than the Gaslight Company in 1888, in 1898 they were 7¼d. better.

The Chairman: What other point have you to make?

Witness said he desired to put in another table as follows:—

Net Coal and Working Expenses, less Rates, per 1000 *Cubic Feet, of the Three Metropolitan Gas Companies.*

Period.	Mean Averages of Four Years.		
	The Gaslight and Coke Company.	South Metropolitan Company.	Commercial Company.
	d.	d.	d.
1883—1886	20·45	17·04	19·13
1887—1890	17·71	16·30	16·34
1891—1894	20·52	17·30	19·83
1895—1898	19·24	17·10	19·21

They had had, he said, Mr. Haward's comparative statement for a certain period, and Mr. Hunt's for another. There was always a difficulty in dealing with one single year and another; and for the purpose of comparison he would rather extend the field. He had taken the period commencing with 1893—the first year after the last amalgamation, with the London Company—and ending with 1898; and he had taken out the net coal and working expenses apart altogether from the question of rates. He had divided it into four periods. In the period from 1883 to 1886 it cost his Company 20·45d. to make gas; in the next period that was reduced to 17·71d.; and in the last period it was 19·24d.—showing a reduction on the figure for the first period of 1·21d. The figures of the Commercial Company were very close to these. Throughout the whole period—if there was any soundness in the view he took—his Company had done slightly better than either of the other two Companies. It was true that in the first period his Company were more costly than the South Metropolitan Company by 3·41d., and 1·32d. than the Commercial; but the Committee would see that they had made up a considerable amount of the difference. While the expense to them was now about the same as to the Commercial Company, it had been reduced to less than 2d. more than that to the South Metropolitan Company. One embracing figure covered the whole thing. These figures he contended disposed to a large extent of the charge of mismanagement and reckless extravagance.

The Chairman: The other Companies began better than you?

Witness: Yes. I have pointed that out.

Mr. Cohen: If you began by being expensive was there not more room for improvement in your case? Would it not be reasonable to expect more from you than from a Company who did not offend so much at the beginning?

Witness: Yes. The figures show that no one has appreciated more than the Directors of our Company the disadvantage we were under at the beginning.

What is the first year you have taken?—The first year after the last amalgamation, which seemed to me a good period to take.

Mr. Lough: Good for you, but not for them. Had the other Companies any amalgamations?—No.

The Chairman: You say that for the last four years your average working expenses have been about the same as those of the Commercial Company, and less than 2d. more than those of the South Metropolitan Company?—A little over 2d.; 2·14d.

Is there anything else you have to say about Mr. Hunt's evidence?—Mr. Hunt speaks about our having the whole of the north of London for the supply of coke. Well, there is no such thing as the monopoly of a district for the sale of coke. The different Companies send their coke where they can find the best market for it. We in the north of London are exposed to serious competition from Birmingham and the Midlands. There is a large amount of coke brought in from the Midlands.

The Chairman: You say that Birmingham sends coke to North London, notwithstanding the cost of carriage?—Yes. I only recently heard of a transaction in which a London dealer purchased 40,000 tons from the Midlands.

You contend that Beckton is not a good market?—No; but we do as the Birmingham people do. We send out coke to dealers, nurserymen, and contractors. I do not know what the Birmingham or other people get for their coke.

The Chairman: You have something to say as to Mr. Trenner's evidence.

Witness: Yes. But there is only one thing I care to speak of. He referred to the cost of electric lighting. He said that the people of Holborn were so dissatisfied with the price of gas that they had decided to light the Holborn Town Hall with the electric light to effect economy. Unfortunately, Mr. Trenner did not go into figures as to the cost of the lighting. But I have got them out very carefully myself; and I find that the cost of lighting the hall was £293 in 1891 and £303 in 1892. They then introduced the electric light, and paid for gas £205, and, in addition to that, £255 for electricity. So that, instead of the lighting of the hall costing £293 as it did in 1891, it cost £460. And the same thing has gone on year after year. In 1895 it was £456; in 1896, £483; and in 1897, £492. So that it does not appear from the figures that there is any direct economy effected by the introduction of the electric light.

Mr. Lowles: Is it not the fact that the hall is more frequently let now than it was formerly—more used by the public who pay for it—because in that way the Local Authority would be reimbursed?

Witness: That may be so; but their gas account is still £224.

Did not the witness say that people who use gas-engines have gone from the north of London to the south in order to have cheaper gas?—Well, we have 4000 gas-engines in our district. The number has increased rather than diminished of late years. There is a fallacy in Mr. Jones's evidence. He gives a comparison of sales of gas per unit of main; but there is a fallacy in it because one main may be a 40-inch main and another may be a 3-inch main. Mr. Jones, in his replies, spoke of reduction in charges for capital; but I do not think he gave the Committee all the figures. He started with the figure for 1881, and compared it with that for 1888. The reduction in the cost of capital in that period was: Gaslight Company, 3·82d.; South Metropolitan, 5d.; Commercial, 2·42d. Taking the whole period from 1876 to 1898, the reduction in the case of our Company was 3·75d.; in that of the South Metropolitan, 4·32d.; and in that of the Commercial, 1·95d. As to reduction in working expenses and improvements, the figure in the case of the Gaslight Company, has been more marked than in the case of the Commercial Company though not quite so good as in that of the South Metropolitan. The latter have a larger increase of business than we have. With regard to Mr. Morton's evidence, it does not appear to me to call for comment. As to Mr. Doughty's evidence, it is to the effect that the lowest price charged for gas in London should be applied to the whole of the Metropolis. This policy would mean almost complete annihilation of dividend on this Company's ordinary stock.

The Chairman: The answer to him is that such an operation would be impossible?

Witness: Yes. It would cost £75,000 a year—that is a 10d. reduction; and the loss of this profit would reduce the amount available for paying dividends by £122,212, or just enough to pay 1⅞ per cent. on our capital account. Considering that we have to go to the public every now and then to raise more capital, I should like to know what rate we could raise it at if we were to pay only 1½ per cent. on ordinary stock? I must ask the indulgence of the Committee with regard to the evidence of one other witness—Mr. George Livesey. I wish to prepare my reply to him carefully. I am not ready to give it to-day. If the Committee will allow the Engineers who have evidence to tender as to the construction of works to follow on now, and let me at a future sitting reply to Mr. Livesey, I shall be glad.

The Chairman: You have, of course, referred to Mr. Livesey's evidence by implication?—Yes, on one or two points; but his evidence is too important to be dealt with in the byways of evidence. I would rather deal with it as a whole.

Mr. Lowles: What Engineer do you wish first to call?

Witness: Mr. Foulger.

The Chairman: I hope that you will be in a position to deal with Mr. Livesey's evidence on Tuesday, and that the Committee will be able to finish your cross-examination. I hope the evidence can be closed on Tuesday.

Witness: We have one or two Engineers to offer to-day; and I do not think their evidence will take very long.

Mr. George F. L. Foulger *was then called.*

Examined by the Chairman, witness said: I am the Distributing Engineer of The Gaslight and Coke Company, have held this position for ten years, and have been altogether 34 years with the Company. During the whole of this period I have been engaged in the technical and practical part of gas distribution.

The Chairman: What does that mean?

Witness: I am responsible for the whole of the outside engineering works. As Distributing Engineer, I take charge of the whole of the gas manufactured at the different stations of the Company as it leaves the various works. I will first show the exceptional difficulty in opening and reinstating the expensive paved ways within The Gaslight and Coke Company's area, as compared with similar work performed by any other Gas Company. Our area, as you have heard, is 63 square miles; and the roads throughout are largely paved with wood or asphalte, with concrete foundations. The cost of reinstating roads of this kind after they have been opened up to lay or repair pipes, is as high as 21s. per square yard. The whole of the City of London, with the exception of the Thames Embankment, is paved with either wood and concrete or asphalte. Going to the City boundary, where we join the area of the Commercial Company at Aldgate, you cannot in the main streets get away from asphalte or wood. The cost of reinstating a road paved with granite cubes—with which the district of the South Metropolitan Company is principally paved—is 2s. per square yard. The cost of reinstating an asphalte road is 1s. 9d., and a ballast road 1s.

What does the reinstatement of a wood pavement cost?—It goes as high as 21s.

Mr. Steadman: What is this "ballast"?

Witness: Gravel in the side streets. The reinstatement of a Jarrah or other wood street includes the cost of the concrete.

The Chairman: You mean that to break up one yard of wood pavement, and to put it back into its original state, costs about 21s?

Witness: No, the cost of reinstating only.

Can you give us the cost of breaking up, which must be added to the reinstatement?—I am afraid I cannot. The labour is very much greater in the case of wood or asphalte streets than in other streets. It will take a man pretty well a day to break up a yard of concrete. The whole of it has to be broken up with sledge hammers and steel wedges. The breaking up is purely a question of labour.

And still the fact of cost is important. Your contention, I suppose, is that you have to deal with a material expensive to work?—Yes; that the expense incurred in the distribution of gas—in laying mains and service-pipes, and opening the ground and reinstating expensively-made streets and footways—seriously handicaps us when compared with Companies who are comparatively free from such expense.

Mr. Lowles: But to make this evidence effective, we must have the figures.

The Chairman: Yes; and we must know the nature of the ground all three Companies have to deal with, and the area of each.

Mr. Cohen: Yes; the area of each class of pavement—how much they have of the expensive kind, and how much of the cheap kind.

Witness: I am afraid that to give this information would mean a survey of the whole of the streets of London.

Mr. Lowles: You have a figure representing this particular work?

Witness: I could give you the cost in relation to each main job we do.

The Chairman: Can you give us the figures for a mile, so as to compare your Company with the South Metropolitan Company?

Witness: I could give you a mile of main; but it would be an intricate comparison to make if I had to deal with the absolute number of miles of mains of each Company. It is only fair to tell the Committee that the bulk of our mains were laid down before this expensive system of paving came into vogue. Therefore we are affected now more in the direction of wear and tear, and in dealing with the mains that were originally laid down, than in regard to original outlay.

Mr. Lowles: It has not affected your capital so much as your working expenses?

Witness: That is so; but at the same time there is no doubt that, from the earliest period, the pavement of the City has been of a more expensive kind than that of the districts supplied by the other Companies.

But there is a set-off against that in the new streets, such as Northumberland Avenue. There is room for the mains to be put under those streets?—Yes; in subways. But in subways the wear and tear of the pipes is greater; they are subject to every change of temperature. We have more escapes from mains in subways than in those which are protected by having soil around them.

Mr. Steadman: There are subways in the City, are there not?

Witness: There are about twenty altogether.

The Chairman: When a row of new houses and a new road are being constructed, I suppose you lay your mains before the pavement is put down?

Witness: We endeavour to do so; but we have no power to lay mains in private roads. We only have power to break up roads when they have been dedicated to the parish. Sometimes the owners of the roads try to extract a rent from us. In that case, we should not be able to lay the mains before the roads were made up.

But most of the roads are not private?—They are private when first laid down.

By the time the houses are built and the streets are laid out, do they not come to you and ask you to lay your mains in the streets?—The parish people will not take the roads over until they are all made up.

Do you as a general rule lay your mains before the road is made or after?—As a general rule before. By Act of Parliament, when we open up a road we have to make it good again with the same material. With ballast it is, therefore, very inexpensive; but with wood and asphalte we are bound to use fresh materials—concrete and blocks. What renders the work more expensive is that we cannot finish it right off. We have to wait for it to set, which necessitates watching. Then we find great difficulty in tracing escapes of gas under the hermetically sealed roads within our area. In the case of ballast or macadam roads, a fracture is detected near a joint of the main. In the case of wood and concrete or asphalte, the road is impervious to gas; and it traverses long distances before it can be localized. This entails heavy expense in opening roads and reinstating them. We have to use great force in breaking up roads; and we frequently find that escapes are caused in this way or by work in connection with the laying or repairing of telephone wires, electric light wires, or by water companies in opening up the roads for their purposes. Escapes often occur in consequence of roads being waterproof. When rain comes down on a ballast road, it sinks in at once, and helps to consolidate the soil; but as the pavements to which I refer are waterproof, the rain, instead of helping to consolidate the soil, runs down the gulleys and sewers, leaving the sub-soil dry. The peculiar vibration and tremor caused by the ceaseless traffic in London, creates a tendency in the dry soil to slip away from the mains. The mains are acting as girders to the road; they have to be frequently examined for the purpose of keeping them up, and seeing that they have adequate support. The question in connection with the pavement equally affects the service-pipes; and we have to open the roads in order to get at the pipes leading to the houses. The South Metropolitan Company have not to deal with such roads as we have. All round places like Blackheath they are either ballast or macadam roads.

In further examination, witness pointed to the numerous obstructions in the main roads of London. It was difficult to lay mains, he said, owing to the very large number of underground pipes, such as probably were not equalled in any other city in the world. Frequently, in order to get mains properly laid, it was necessary to go to the owners of obstructions and get them to alter their works. He had in his mind a high-pressure main, 2 miles long, which they laid two years ago. In order to lay it, they had to alter the water-mains, and all the gulleys, so as to clear the channel for the main to rise. This was due to the fact that the roads in the district were so terribly full of obstructions.

The Chairman: Your point is that streets in your district are much more full of obstructions than those in the South Metropolitan Company's district?

Witness: Yes; and the streets are much narrower in the City. Then gas-mains, unlike water-mains, can never be laid upon a level. They are always laid with a slant, so that the condensation from the gas may fall into reservoirs, from which it is pumped periodically. This makes it more difficult and expensive to deal with these mains; and in our case the expense is largely augmented by the fact that the roads are already so full of obstructions. We have to dip the mains every now and then, so as to put a syphon for the collection of the condensation.

Mr. Lowles: Do all Gas Companies have to face this difficulty?

Witness: Yes; but if you are dealing with a road free from obstructions, you can run your pipes a greater length without syphons.

The Chairman: You say your district involves a great many more syphons?

Witness: Yes; and they have to be frequently attended to and pumped. Having our works so far from the source of supply, it necessarily requires that the main should be of larger capacity than would otherwise be needed; and there comes in a difficulty which we experience in crossing bridges, and so on. We have no power to go inside the structure of a bridge. If we find depth of road enough to bury the pipes in the soil, our statutory powers are adequate; but if there is not sufficient depth, it is necessary to get permission to go into the structure of the bridge. Witness produced photographs showing the difficulties he was describing. He pointed out that in one instance where they had been unable to bury a main in crossing a bridge, they had had to make arrangements with the London and North-Western Railway Company to carry their pipe outside the bridge. They had to make a small bridge for it on purpose. In consequence of their works being so far away, it was necessary to use mains of much larger capacity than those employed by either the South Metropolitan or the Commercial Company.

What depth would you consider the greatest?—I should say 3 ft. 6 in. The average depth of mains is 2 feet; but if we go 3 ft. 6 in., we should think it necessary to insert syphons.

Do you wish the Committee to infer that the depth you have to go to is greater than with the other Companies?—Not at all; but I wish to convey to the Committee that we frequently have to go deeper to clear these obstructions. Wherever we do meet with an obstruction, we have to go down under it; and wherever we dip, we have to insert a syphon at the lowest point. When we go deep down, we require to have special castings, and to make special arrangements to burrow underneath every obstruction.

Have you any figures to give us as to the cost your Company are put to in laying these mains and service-pipes?—I can give you the cost of laying mains under such conditions, and compare them with the cost in the ordinary way.

Those would be vague figures. They would not give the information as to the actual cost you are put to under this head?—It is difficult to get two pieces of work absolutely alike, to make comparisons. I start with the small-sized mains. The cost of a 3-inch main, under ballast, is 3s. 8d. a yard.

The Chairman: This I understand is only the cost of laying—not of the pipe itself?—Yes; it is the whole cost—the excavation, the laying of the pipe, the pipe itself, and re-instating—per lineal yard.

Does laying a lineal yard mean that you have to open up a square yard?—No; not quite. Under ballast, with a 3-inch main, we should open a trench 2 feet wide; but in other pavings we should have to open 3 feet, because with (say) wood blocks you cannot repair them up to a square edge—there is always the bonding. The cost of laying the same sized main under macadam would be 4s., under cubes 4s. 8d., under cubes on 6 inches of concrete 6s., and under wood paving from 15s. to 21s. 6d. Very often we are able to curtail the openings by cutting a narrow trench along the pipe, but widening out at the joints. The cost under asphalte is from 14s. to 18s.

Mr. Lowles: You have a greater proportion of large mains than the other Companies?

Witness: Yes; a very much larger proportion. Our mains really have to act as gasholders, because we are dealing in some cases with gas very nearly 20 miles away from the source of supply. We take the gas without the intervention of any gasholders whatever from these mains.

The Chairman: Do you mean you have your mains so large that they are actually gasholders?

Witness: Not exactly that. The usual system of distribution with the South Metropolitan and Commercial Companies would be to allow the gas to gravitate through the district governors from the holders themselves; but in consequence of our having done away with four works, we have had to run a system of high-pressure mains in order to pick up the outlets which formerly existed at those works. Therefore we have to rely on the pressure which we can maintain in these large mains, and make them do the same duty, in effect, as gasholders do with the other Companies.

How do you get the pressure?—The pressure is pumped. The whole of the gas is pumped from Beckton, and exhausted at the outlying stations. The pressure, although enormous for gas, is very slight on the pipe itself. The heaviest pressure we start at Beckton is 300-10ths, which will balance a column of water 30 inches high; but the pressure on the pipe itself would not amount to more than 1¼ lbs., and a main will stand a pressure of 60 lbs. It is therefore not necessary to have a main stronger because of the pressure.

Does it add to your cost?—Yes; it necessitates having duplicate mains, because no consumers can be supplied off these high-pressure mains direct. Assuming we did put a service on one of these mains by accident, we should blow the whole of the water out of the chandeliers in the houses. Therefore the mains have to be intersected with a governor, and the gas reduced down to normal district pressure, which would be on an average about 18-10ths in the daytime and 25-10ths at night, against 300-10ths in the high-pressure main.

Is your contention, then, that you have these elaborate district arrangements, and the South Metropolitan Company have not?—Quite so.

And the necessity for them is that your works are farther away from your area of supply, and also that you have more obstacles and obstructions to deal with than the South Metropolitan and the Commercial Companies?—Yes; and also that we have to run these mains to pick up the outlets which exist at the manufacturing stations which have been done away with.

Now have you something to say with regard to the electric light competition as affecting the distribution department?—I think it would be idle to attempt to disguise the fact that the electric light in our district has very seriously interfered with our increase. There is no doubt that it is so. Our district, from a gas point of view, would have been everything which Mr. Livesey described it, if we had been as free from electric competition as his and the Commercial districts. But we have to divide the lighting portion of our area with no less than twenty Electric Lighting Companies or Vestries supplying current. If we had the whole of the lighting which these twenty Companies or Vestries have, I agree with Mr. Livesey that it would have been the finest district in the world; but we have not got it. When electric light first threatened gas interests, nearly twenty years ago, it put gas companies on their mettle; and they sought in every direction for usages for gas, in addition to lighting. I allude to gas for heating, cooking, motive power, and ventilating purposes. The Gaslight and Coke Company, with great energy—and the South Metropolitan and the Commercial Companies with equal energy—pushed the use of gas in these directions; and I contend they received an enormous benefit because they followed our example in this matter, without having any of the disadvantages which were the primary cause of our opening out in that direction—the competition of the electric light. Not having the competition of the electric light, everything they secured was a distinct gain; whereas in our case it was only replacing what we were losing to some extent.

But with regard to new houses built in your district, do you find many like electric light instead of gas?—I have personally canvassed the owners of large blocks of buildings; and they have told me facts. They said: "If you were to give us the gas for 1s. per 1000 cubic feet, we should be bound to have the electric light, because it is the fashion now. No high-class residential property is ever built without it; and if we fitted up the gas, we should not let our premises." There is no use denying this. It is not a question of the price of gas. In these high-class houses they will have what is fashionable. With all our canvassing, we are unable to keep the electric light out from property of that class.

Then it is in property built on old sites, which you formerly supplied with gas, where you have your loss?—Yes; in the new streets which are cut through various parts of our district from time to time.

Mr. Cohen: You do not believe the price of gas has been a factor in any way strengthening the competition of the electric light?

Witness: Not the slightest.

The Chairman: Has your consumption under the head of stoves and purposes of that sort in any way kept pace with the loss you have incurred from not having gas used for lighting?

Witness: Well, we are not getting anything like the increase which the South Metropolitan Company have been having; and I cannot help putting this down to a very large extent to the loss by electric competition. In consequence of the crowded condition of many of the streets in our district, it is absolutely necessary for us, when opening the ground, to cart away temporarily the whole of the soil excavated, make the repair, and then bring back the soil—thus incurring a heavy expense in carting.

Do the South Metropolitan Company not have this to do?—I say there is no other Company in this country, except ourselves, who have to do it.

Surely the streets in the South Metropolitan district are not so wide?—There is not the traffic through them.

They can block them up?—Yes; I am only dealing with the busy streets, where ceaseless traffic is going on, which causes the very thing we have to seek for—escapes.

Witness went on to explain how difficult it was, where there was water-

proof, or almost hermetically sealed, pavement, to localize a fracture; it being sometimes discovered by the appearance of gas half-a-mile away. He contended that these fractures were more numerous in his district, owing to the great traffic; and that they gave more trouble to locate. With regard to the electric light, Mr. Jones admitted that he had none in his district, except that which was generated by private gas-engines. The cost of gas consumed in working the engines to produce the electric light was as much as the cost of the gas to light the premises would be. This proved that people were prepared to incur something beyond the cost of gas to get the electric light.

The CHAIRMAN: Therefore you say there is no loss in the district to which Mr. Jones referred?

Witness: Yes.

Your point is that in your area the Electric Lighting Companies do not employ your gas?—Quite so; they do not.

Witness (continuing) said the main streets of his district were mostly lighted by electricity, which affected the Company materially in their lamplighters' wages. The Company had roughly about 53,000 lamps at present; and the average number a lamplighter attended to, before the introduction of the electric light, was 100. Since the introduction of electricity, however, and the lighting of the main streets by electricity, the lamplighters could only take 80 lamps; because they had to traverse the same amount of ground—cross and re-cross the main roads—to get at the side streets. The Company could make no reduction in wages, because the men had as much work to do for the 80 as formerly for the 100 lamps.

Mr. LOWLES: The cost is increased 20 per cent.?

Witness: Yes.

It would probably mean £100 a week, or more?

Witness replied that it would. He went on to say that all the large consumers of electric light had retained their gas-fittings in case of failure of the electric current; and these failures occurred at the times that the heavy demands otherwise were made on the Gaslight Company. Mr. Livesey suggested that these extra demands should be met in some way by reducing pressure. Witness was perfectly certain that if Mr. Livesey had had underground railways in his district, with signals lighted by gas, as the Gaslight Company had, he would never have suggested reducing pressure—especially at times when it was already reduced sufficiently, if not too much. The whole of the signals on the Underground Railway were lighted by gas; that was a fact Mr. Livesey must have overlooked. Witness referred briefly to Mr. Hunt's evidence regarding slot meters. So far as distribution was concerned, a service was a service; and it cost as much, if it passed 16,000 or 17,000 cubic feet, as one passing a much larger quantity. A smaller service required even more attention than a large one, because it was more likely to be choked up by naphthalene. By the adoption of slot meters, the number of consumers in the Gaslight Company had been increased from 200,000 to 300,000. Turning to the question of levels, he said the Commercial Company's district was absolutely at a dead level, and therefore the easiest of the three Companies for distributing gas. They had absolutely no difficulty in this respect, for gas would gravitate from the holders so long as there was gas in them. With the Gaslight Company, the levels varied from 10 feet below, to no less than 400 feet above, Trinity high-water level. This necessitated the use of valves, valve-houses, and other costly arrangements to ensure that the low-lying portions received adequate pressure. Gas pressure increased 1-10th for every 10 feet of rise; and therefore, unless they had the means of checking the pressure, in a district of such varied level they would get a very undue pressure in the higher portions. So that the expense of distribution involved in these valves, pipes, &c., could not be compared with those of a Company absolutely on a dead level. Then Mr. Jones said the Commercial Company had no high-class residential property. He described his district as a working man's neighbourhood; and alluded to the large area occupied by the London Docks, where no work was done after 4 o'clock. This was perfectly true. But in referring to the docks in his district, which burnt very little gas, Mr. Jones omitted to mention the very large number of factories, wharves, and engineers' shops, incidental to the neighbourhood of docks, and factories generally, which burnt gas very freely, because a working man's neighbourhood implied a colony where working men lived near their employment. The effect of these factories in 1898 was to bring Mr. Jones's average consumption per customer to no less than 69,547 cubic feet, against 59,422 cubic feet with the Gaslight Company—a difference of 10,125 cubic feet per consumer per annum. In this calculation, he reckoned each house or factory as a consumer, and included slot-meter consumers in both cases. From a purely gas company's point of view, the Gaslight Company would be quite willing to exchange Regent Street and Piccadilly for an equal length of Whitechapel or the Mile End Road. Mr. Jones had also stated that, excluding slot-meter consumers, his customers remained practically the same as they were eighteen years ago. Yet the Commercial Company during this period obtained even a larger amount of increase in their total gas sales than the Gaslight Company, though the latter Company, to obtain the increase they did, had to lay no less than 566 miles of cast-iron mains, and had 57,304 ordinary consumers. The reason was undoubtedly that in the East-end, though the ground had been covered for many years, it was continually becoming too valuable to be occupied by the small class of property previously on it, and was always giving way to larger property; and fortunately for the Company, as there was no electric light in the district to be installed in the larger property, it still consumed gas. The Gaslight Company were perfectly alive to the value of a working man's district, because at the extreme east of their area they had a district—Canning Town, North Woolwich, East Ham, and West Ham—which was even more a working man's district than the area of the Commercial Company. In this district, where they had bigger factories and docks even than in the Commercial Company's area, they had no electric light competition; and the average consumption, per customer, there was no less than 113,000 cubic feet last year, against the Company's general average of 59,000 cubic feet.

The CHAIRMAN: The broad inference you want us to draw is that a working man's neighbourhood is as good for a Gas Company as a West-end district full of large shops and residences?

Witness: Very much better.

Mr. COHEN: Your opinion is based, not so much on the presence of the poor man's neighbourhood, as on the existence which it implies, of large factories?

Witness: Exactly.

In further examination, witness pointed out that the City of London (part of the Gaslight Company's area) was practically deserted after about 7 o'clock. The buildings were all offices. There were no residents; and practically there was very little gas consumed, except in the East-end big marketing thoroughfares where gas was going till 11 or 12 o'clock at night. The Gaslight Company would be glad to exchange the whole of the City district for an equal district in Mr. Jones's area. With regard to the West-end, too, there were no big shopping centres open late at night. Early closing was very rigidly carried out; and practically no shopping was done at night.

Witness went on to say that the next point was as to slot meters. Mr. Livesey had said that the Gaslight Company fitted up the supplies at a more costly rate than the South Metropolitan Company, and employed a 5-light meter where a 3-light one would do. But they fitted up 5-light meters so as to be within the law. The cost of each supply to the South Metropolitan Company was £6, but in the case of the Gaslight Company it was £7; and this had in some quarters been condemned as extravagance. But the Sales of Gas Act, 1859, clause 16, said that every consumer of gas "might purchase and use for the measurement of the gas supplied to him any meter, provided that the gas consumed per hour should not exceed the quantity per hour the meter was intended to measure, as marked on the outside thereof." A man might have 100 lights in his house and be within the Sales of Gas Act if he could show that he only used three at a time. But a man with a 3-light meter who was using a gas cooking-stove burned a larger quantity than the Act contemplated.

Mr. COHEN: Has this point been dealt with by a Court of Law?

Witness: No.

We are not a tribunal competent to decide this legal point?—No; but we do not think we should be carrying out the provisons of the Act if we put in 3-light meters, which are only meant to pass 18 cubic feet of gas per hour.

Have the Companies taken steps to test the legality of the 3-light meter?—No. We were aware of the clause in the Act, and used the 5-light meter. It would be for the South Metropolitan to find out the legality of the other meter.

Mr. STEADMAN: A man with a 3-light meter may use only one light at a time; and he may have a stove going also. Would there be anything illegal in that?

Witness: It is illegal if more than the quantity of gas marked on the meter is used per hour. You can overwork a meter.

The CHAIRMAN: When you get to the end of your pennyworth, you put in a fresh penny?—Yes; but you may pass 30 cubic feet of gas through the meter when it is only registered to pass 18 feet. In every case where there is a stove attached, I contend that a 5-light meter ought to be fixed. The registration of the meter must be upset by overworking it. Mr. Livesey says that, under such circumstances, it works slowly; but that is not my experience. Overworking has a tendency to make a meter go fast, the drum not having time to empty itself; therefore it is to the disadvantage of the consumer.

Mr. STEADMAN: Suppose you put in a 5-light meter, the consumer gets no more for his penny than if he had a 3-light one.

Witness: No; but with a meter which is too small there is a tendency for it to go too fast, and that works out to the disadvantage of the consumer.

The gas would come out more quickly?—No; the meter would register more than the quantity consumed. We are taking care of the interest of the consumer. Another way in which we do it is to give him a governor burner. It is weighted with a float, and so arranged that under no pressure can you get through it more than the quantity of gas which it is calculated to pass. We feel that if we tell a man we give him 22 cubic feet of gas for 1d., and give him a burner which passes 4 cubic feet an hour, he has a right to find the light last for 5½ hours. If it does not last that time, he knows that something is wrong. He has a means of checking the meter. We put a governor burner in each house at a cost of 2s. 6d. In the case of the ungoverned burners issued by the South Metropolitan Company, they go up to 9·30 cubic feet, and give less light than our burners. It is clearly to the advantage of the consumer that his burners should be governed. With an ungoverned burner a man gets more gas than he requires. Some of it is burnt, and some is deposited in the shape of carbon on the ceiling and the ornaments in the room. Then we serve out substantial brackets, knowing that working men will sometimes use these things to hang their coats on, and so forth. We put the best quality of fittings in the houses. This has always been the policy of our Directors.

The CHAIRMAN: Your point is that you give better furniture than the South Metropolitan?

Witness: Yes. But we have not lost sight of our own advantage. A meter worked at its normal capacity will last longer than one overworked. Our fittings will last longer than those of the South Metropolitan Company.

By Mr. COHEN: The competition with his Company by the electric light commenced ten years ago.

Mr. G. C. TREWBY, the Consulting and Constructing Engineer to The Gaslight and Coke Company, *was then called.*

He said he had had 45 years' experience in the manufacture and distribution of gas, and had been in the service of the Gaslight Company as Engineer for upwards of 34 years, and was the first Resident Engineer at the Beckton works, the largest gas-works in the world. He proceeded to criticize Mr. Hunt's evidence to the effect that the Company had spent an undue amount on capital account—greatly exceeding that ordinarily regarded as sufficient, and which had been found to be so in respect to other gas undertakings. In the case of the Gaslight Company, they had added to their manufacturing power during the last ten years to the extent of 29,750,000 cubic feet, at a cost of £1,364,870, or £45·87 per 1000 cubic feet of daily make. It would be seen by the table which he handed in (see column one next page) how the money had been expended. Included in the above expenditure was a sum of £313,997 which might fairly be taken as outside the expenditure of an ordinary gas undertaking, and came particularly heavy on the last ten years, because during that period the Company had to make a new departure—the erection of an additional pier capable of discharging four large steam-colliers at one time, properly equipped with powerful hydraulic cranes, and labour-saving appliances in the shape of stoking machinery (which Mr. Hunt

Capital Expenditure at all Manufacturing and Storage Stations (Ordinary Oil Gas and Extraordinary) during the Years 1889 to 1898 Inclusive.

Ordinary expenditure	(A) ..	£1,050,873
Extraordinary expenditure—		
Stoking machinery	£71,053	
Exhausters, &c., for clean gas, Beckton	3,725	
Lime-revivifying plant, Beckton	5,351	
Cyanogen plant, all stations	23,250	
Dredging plant, Beckton	1,104	
Stables, Beckton and Bow Common	4,558	
Viaduct for coal storage, Beckton	47,057	
Do., Nine Elms, St. Pancras, Bow Common, and Haggerston	8,253	
Pier, Beckton	64,580	
Jetty for export coke, Beckton	15,716	
Hydraulic machinery for coal, Beckton	42,783	
Do., Nine Elms, Bow Common, and St. Pancras	9,192	
Permanent-way trucks	17,375	
		313,997
Grand total		£1,364,870

	Cubic Feet.
Increase in manufacturing plant during the above ten years	29,750,000
	£
Cost of foundations at Beckton during this period over and above what they would cost elsewhere in solid ground	99,672

Cost reckoned on the total amount = £45·87 per 1000 cubic feet of daily manufacturing plant.

Cost reckoned on "A". = £35·32 "

Do. if worked for 197 days, and deducting 5 per cent. for unaccounted-for gas } = £188 per annual millions sold.

did not give them the credit of possessing, and volunteered the statement that, in consequence, the Company were behind the times), grabs, coal-storage plant at various stations, and plant for the recovery of cyanogen, &c. If a deduction were made for this extraordinary expenditure of £313,997, the balance of £1,050,243 worked out at the very low figure of £35·32 per million, notwithstanding the heavy expenditure to which the Company were put in sinking the foundations at Beckton, where they had to go down 30 feet to get a bottom. The South Metropolitan Company did not need to go down to anything like that depth.

Witness continued: The Company were led on to provide increased manufacturing power from time to time during the last ten years by the increase shown in the consumption during the years 1895, 1896, and 1897, which averaged respectively 5·77, 4·25, and 4·51—the last occasion being during the December half year of 1896 and the June half year of 1897, when the weekly returns showed very large increases. This expenditure up to the present time had not all been productive, by reason of the very mild winters of late years (especially in the last two years), and the absence of cold and fog in the depth of winter. He estimated that if there was a repetition of such weather as in Christmas week of 1891, when 128,207,000 cubic feet of gas were sent out on one day, practically the whole of their manufacturing power would be required. He mentioned that in that particular week the Company were not able to supply their customers efficiently; and there was not the slightest doubt that if they had had the power they would have sent out the same quantity on the two succeeding days. They had to curtail the pressure to such a serious extent that there were many complaints. His Directors determined from that time that they would have sufficient plant to meet every emergency. It took the Company two years between the time of deciding upon the work of coal-gas manufacture and bringing it into operation; so that the Company must look well ahead. Witness handed in a table showing how the capital per "annual million" would have worked out if the Company had had the increased consumption they were led to expect. In the ten years 1888 to 1899, the Company had an increase of 3,689,357,000 feet. But in 1898 there was actually a decrease on the previous year. If the Company had had weather such as in 1891, nearly the whole of their plant would have been brought into operation; but as it was—taking the whole amount they expended in the ten years—it amounted to £370 per million of increase. If they had had the increase they were led to expect, this amount would have been reduced to £292. This figure was still based upon the ordinary and extraordinary expenditure; but excluding the extraordinary expenditure—if they had had the same use of their plant as other Companies, and on the same number of days, it would have been reduced to £188 per annual million. Therefore he contended they had spent no more capital than they were justified in doing. The figure of £188 compared most favourably with the £300 or £400 per million which Mr. Hunt calculated as necessary for works and distribution. Continuing, witness said that in the last ten years they came to the end of their tether, and they had to construct the new pier and viaduct at Beckton. Mr. Livesey laid great stress on the erection of the four single-lift gasholders at the Beckton works in 1868-70; and on the fact that the Company did not take advantage of the progress in engineering—holding that they should have had double lifts. The Engineer responsible for them died years ago. No question was raised about them by Mr. Livesey until about a year ago. Telescopic holders of large capacity were no novelty when these were erected. Mr. Evans, the original designer of the Beckton works, erected one of 2 million cubic feet capacity years before, outside Millbank Penitentiary. As far as witness understood, Mr. Evans put up these four single-lift gasholders, in preference to telescopic ones, on account of the very exposed position—there being then a two-mile sweep across the Marshes, so that they were exposed to the full force of the wind—also on account of fear of what might happen when the firing of the 100 and 110 ton guns took place at Plumstead Marshes immediately opposite. As a fact, shortly after the opening of the works, one of the holders was completely wrecked in a gale, owing to the negligence of the contractor. It was feared that the firing of the large guns would have the effect, if a telescopic holder were built, of unsealing the holder; and then it would have come down and some damage would have resulted. During the first few years after the works were opened, representations were made to the War Office as to the injury that was being brought about to the works generally from the concussion caused by the firing of guns. The War Office authorities sent officers to watch the effect; and although they noticed a very marked movement of the holders when the heavy guns were fired, and made their report, the only answer received from the War Office, as far as witness was aware, was the one in the correspondence handed in.

Witness went on to read a report made by Mr. V. Wyatt, the Constructing Engineer to the Company, on July 24, 1879, in the course of which he stated: "The second of the four new 100-ton guns purchased from Sir William Armstrong by the Government is now being proved at the butts in the Marshes opposite the Beckton works; and there are still two other guns to be proved this month. The vibration and earth movement passing through the works when these guns are fired is very startling; and when one is standing upon the pier, the whole structure is sensibly affected, similar to the explosion of a boiler. The firing of heavy artillery has been known to crack structures of cast iron and masonry. . . . At the gas-works, Shoeburyness, there is a gasholder, 37 feet in diameter, which is stated to have risen vertically 6 inches when the [81-ton] gun was fired. The gasholders at Beckton, which are about 200 feet in diameter, are moved vertically also when a heavy shot is fired, and those in course of construction have the roof-plates moved sensibly and audibly. . . . An attempt has been made at Woolwich to measure the effects of the gun shock and vibration, by putting up a screen; and the force is given as 17 lbs. per square foot of surface. I have been on the pier and gasholders at Beckton when a gale of 37 lbs. per square foot has been blowing; but the effects upon the structures are in no way comparable to the shock from the 100-ton gun." This report was sent to the Secretary of State for War; and the reply stated that Colonel Stanley was not prepared at present to alter the arrangements of the Department. When the Company, witness continued, went to Beckton, the question of these large guns had not arisen. The Government had now altered their whole system by firing away from Beckton, and surrounding the guns by a screen, to reduce concussion.

The CHAIRMAN: What would be the effect now supposing these telescopic holders were dislocated—the two portions were disjointed?—If the lifts were unsealed, the holder would come down with a run, the gas would escape all the way round, and we do not know what might happen.

Mr. COHEN: I do not see how you could have been prevented from putting in telescopic holders at an earlier date because of some risk from guns which only began to be proved in 1879?—We put single-lift holders in because we thought they would be sufficiently safe as far as the guns that were then being proved were concerned. When they increased the size of the guns up to 100 and 110 tons, the Company had some doubt as to the safety of the plant. The Company had put in telescopic holders since; but the heavy guns did not now produce the same concussion as formerly.

The CHAIRMAN: Is it an extensive operation to turn a single-lift holder into a telescopic holder?—Yes it is. After the four single-lift holders were erected, four telescopic holders were put up. Then I myself have put in a holder of four lifts, containing 8 million cubic feet—that is the farthest one from the river. The reason I put that in was that it was essential to have a large holder as the manufacture increased, so as to allow the gas that was made from hour to hour to mix, in order to send up to London gas of uniform quality during the whole 24 hours. Then Mr. Livesey complained that the four original holders had not been converted into three lifts. This matter has been considered, and estimates made; and it was found that it would cost about as much to provide the additional capacity in the shape of one large new holder as to cut the existing holders about and add two additional lifts to them, because we can construct large holders at much less cost. Moreover, Beckton is not the place to provide additional storage accommodation, as, to get the gas into the neighbourhood where it is to be consumed, more main power would be required between Beckton and London. The Company aim at having their gas storage as near to the point of supply as possible, in order to make full use of the high-pressure mains during the whole 24 hours. With reference to the cost of gasholders, including the tank, I cannot agree with Mr. Livesey that anything so low as £5 per 1000 cubic feet capacity will cover the cost of a properly-constructed gasholder and tank. As an instance outside our own Company, I may cite the tank and holder now being constructed for the Birmingham Corporation. An account of this has appeared in the "JOURNAL OF GAS LIGHTING" for Oct. 18, 1898. The capacity is to be 8¼ millions, and the estimated cost £72,000, which works out at £8·725 per 1000 cubic feet; and it must be borne in mind that Birmingham is about the cheapest place in the kingdom, on account of its being surrounded by iron works, for this class of work. It will be interesting to the Committee to know that the dividend and interest (at the average rate for 1898) on the cost of the four tanks and gasholders at Beckton of which Mr. Livesey complains, is only equal to 0·116d., or less than half-a-farthing per 1000 cubic feet of gas sold; and I contend that Mr. Livesey's statement that at least half the money might have been saved when these gasholders were constructed, is utterly unwarranted, considering all the circumstances of the case, and the state of knowledge at the time they were built.

Continuing, witness referred to the figure of £1,000,000 or thereabouts which he estimated as the cost of converting the whole of the Company's retorts to the inclined system, but which operation Mr. Livesey had suggested could be done for £200,000. To prove his figures, witness made a simple calculation of what he estimated the cost, reckoned at per million of daily make. This would certainly not be less than £9000 per million, using up the old materials as far as they would go. Calculating this on the coal-gas manufacturing capacity as it existed in the winter of 1897-8, of 109,730,000 cubic feet, it would amount to £987,570. Taking it another way, at per retort, 20 feet long, and adopting the figure of £100 per retort (which one of Mr. Livesey's own Engineers gave witness in January last, as the cost of an installation at one of their works), and applying the figure to the total number of retorts, 9720, gave £970,200 as the cost.

You contend it would not be financially proper or useful to alter your machinery?—Not all at once. We are doing so gradually, and we are making experiments as to whether it is more economical to introduce stoking machinery for the horizontal retorts, or to wait until they are worn out and then put in the inclined system. That is being watched very closely at the present time. Then I should like to say the Gaslight Company are entitled to take credit for being the first to introduce

carburetted water gas into this country. The more immediate effect of doing so was to bring down the price of cannel, in one case, by 8s. a ton; and Mr. Livesey's and every other Company benefited by that. Several installations have been put up in other towns with a total manufacturing daily capacity of 75 million cubic feet in addition to this Company's plant of 17¾ million cubic feet, making 92¾ million cubic feet in all. Sixty-two towns have adopted it; but the South Metropolitan Company, for some reason which I do not know, have not. The South Metropolitan Company pride themselves on the fact that they sell gas cheaper than the Gaslight Company; and so they do. There are, however, two most important features to be considered, and these are illuminating power and full and efficient supply. The Committee have heard that Mr. Livesey gives us credit, as far as Beckton is concerned (owing to its distance from London) for having to supply a higher quality of gas than his own Company; but there is something more. As you have heard from Mr. Livesey, his method of enrichment only carries as far as the testing-stations. Inasmuch as his testing-stations are on the average nearer his works than ours, it follows that his gas need not leave the works with as high a degree of enrichment as ours. This is fully borne out by the results arrived at by the portable photometer. Although we are decidedly opposed to the legalized use of this instrument, yet—taking it for what it is worth, and taking it for granted that the testings made with it have been performed in the same manner—it would show that the illuminating power of the gas supplied by the Gaslight Company was for the whole year 1897, 1·1-candle power higher than that of the South Metropolitan Company. Then with reference to the pressure, the Gaslight Company lay themselves out to supply the full demand of their customers at all times; and as they have a large number of heating and cooking stoves on their district besides gas-engines, to restrict the pressure would be most inconvenient to customers. We take a very serious view of our position, and would on no account restrict the pressure unless absolutely obliged, or absolved by Parliament from our obligations. The Companies are worked under statutory obligations, which define the very minimum pressure which must be kept up, This amount was prescribed before the large introduction of gas-stoves, and is not applicable now. If there is a foggy day, we do not diminish the pressure—we put it up, because in 1891 we had serious complaints, and were threatened with actions. In fact, people had to stop the use of gas-engines. We say if once people put up stoves and gas-engines, they should have an efficient supply.

In conclusion, witness said the Gaslight Company did not consider they had spent any more money on their works than was absolutely needed. If the Committee had any idea that they had been at all extravagant in their buildings, he invited them to visit the Company's works, as well as those of the South Metropolitan Company, and draw their own conclusions.

The Committee then adjourned till to-day (Tuesday), when it is expected the taking of evidence will be concluded.

HOUSE OF COMMONS COMMITTEE.

Thursday, June 15.

(Before Sir HENRY FLETCHER, *Chairman, Sir* LEONARD LYELL, *Mr.* ROTHSCHILD, *and Sir* W. GURDON.)

BRISTOL GAS BILL.

As amended by the Committee of the House of Lords, the Bill promoted by the Bristol Gas Company asking parliamentary sanction for the raising of additional capital to the amount of £300,000, and the acquisition of further land, &c., came up for consideration by the above-named Committee. In the Second House the only petitioners against the Bill were the Corporation of Bristol.

Mr. BALFOUR BROWNE, Q.C., Mr. ERSKINE POLLOCK, Q.C., and Mr. A. V. FRERE appeared for the promoters; Mr. WORSLEY TAYLOR, Q.C., the Hon. J. D. FITZGERALD, Q.C., and Mr. MOON represented the Corporation of Bristol.

In opening the case for the Bill, Mr. Balfour Browne recapitulated the history of the Company (see "JOURNAL" for March 21, p. 728). He recounted how, under the title of the Bristol United Gas Light Company, two Companies were amalgamated and incorporated under the Act of 1853, with a capital of £181,250, with power to raise an additional £80,000 by the issue of further shares under the auction clauses. The borrowing powers were £85,000; while the dividend payable under the general law was 10 per cent. Subsequent Acts authorized further increases in capital; until, in 1891, the Company obtained an Act granting the conversion of their 10 per cent. stock into double the amount of 5 per cent. stock. Dealing with the section of the 1853 Act which defined the limits of the area of supply, Counsel pointed out that, while the Company were placed under obligation to supply gas within the city and county of Bristol, there was an express proviso reserving to them the option of supplying the rest of their district outside the electoral boundaries. The present authorized capital stock of the Company was £1,022,500, of which £973,500 had been issued. The total authorized loan capital was £255,625, of which £236,520 had been issued. This was the only Company under the obligation to sell, not only their loan capital, but their borrowed capital under the auction clauses. The total amount received under these clauses as premiums on shares and debentures, and which bore no interest at all, was £228,777. Not only as to the principle of selling new shares by auction, but also with regard to the "splitting" of stock, the Bristol Gas Company might be considered a pioneer among gas companies. Owing to the premium at which shares were issued, the 10 per cent. dividend did not, of course, represent the actual return on the money of the investor. The constant payment of the full dividend, however, had led to so much discontent among employees and consumers—the latter arguing from the fact that they were paying more than they ought for their gas—that many other gas companies had since followed the example set by the Bristol Company, including the South Metropolitan Company and The Gaslight and Coke Company, and had come to Parliament for Bills authorizing the conversion of their capital. Counsel called particular attention to section 32 of the Act of 1853, under which the Corporation were entitled to require from the Company a supply of gas to any public lamp within the city and county of Bristol, situate 25 yards from any main, at a price equal to the lowest price charged for the time being by the Company to any private consumer. Although the maximum price was 4s. 6d. per 1000 cubic feet, the actual present charge was 2s. 4d. per 1000, subject to a reduction of 2d. per 1000 cubic feet for large consumers. The section laid the Companyunder a very serious obligation. The Act of 1853 only applied to the old borough of Bristol; and the Company's position under that Act had been expressly safeguarded by a clause accepted by the Corporation when they came to Parliament and obtained an extension of the boundaries. Counsel read letters showing that on the faith of the undertaking, the Company withdrew their opposition to the Corporation Bill. As he understood it, the object of the present opposition was to place the Company under the same restrictions in the extended area of the Corporation as they were under with regard to the old borough. In the old borough, the Company were, at their own expense, bound to raise or lower pipes as the Corporation gave them notice. They objected to be placed under this obligation with respect to the larger area. Under the general legislation of the Gas Acts, and before pipes were laid down, they were required to get the approval of the Corporation. It would be a great hardship, after having laid down pipes in one of the streets in the outside area, if the Corporation had the power to compel the Company, at their own expense, to take the pipes up again and lay them somewhere else. Although the Company were not bound to do it, they had reduced the price of gas to the same level throughout their whole limits, both inside and outside the old borough. In 1891, in order to encourage the consumption of gas, the Company obtained power to supply cooking-stoves and fittings. At present they had 7155 gas-stoves on hire, and altogether 26,178 consumers. They now desired to have power to sell gas for purposes other than lighting. In these days, it was most important that gas companies should as far as possible extend their usefulness, as they were subject to the very serious competition of the electric light, especially when in the hands of a Corporation as it was in Bristol. While the Company were under obligation to supply gas for the lighting of the public streets, the Corporation were under no obligation to take gas from the Company. As a fact, the Corporation had lighted all the principal streets of the city with electricity; and now merely took gas from the Company for the outlying districts, where it was not so remunerative to supply. Ten-and-a-half miles of streets in Bristol were now lighted by electricity. The Gas Company were under obligation to supply the Corporation at the lowest price charged to anybody in the town for domestic purposes. If the Company could extend their business, and supply gas for power and heating purposes, they would secure a remunerative return. Gas was much easier to store than electricity. At present the Company had a very small day consumption—mainly for cooking purposes. They wanted to get what was called a day-load; and in order to do so it was necessary that they should be able to supply gas at a rate which would be cheap enough to induce manufacturers to take it for power purposes. Counsel laid stress on the advantage which would accrue to the public if the Company were allowed to supply gas for power purposes at a cheaper rate than the domestic supply in competition with the electricity of the Corporation. Referring to clause 19, which provided that the price charged to any consumer of gas used for other than lighting purposes should not be taken into account in ascertaining the lowest price to be charged to the Corporation, Counsel said it would be simply monstrous if, owing to the necessity of keeping up the price in order to get a remunerative return out of the Corporation, the Company should be prevented from supplying gas for other than lighting purposes at a cheaper rate. The result would be to deprive traders of the option of using either gas or electricity for power purposes. He quoted the prices charged by the Corporation, to show that they themselves differentiated between a trade and a domestic supply; the charge for electricity for lighting purposes between midnight and one hour before sunset being ⅔ of 5d. per unit, and at other times 5d. per unit, both charges being subject to from 5 to 25 per cent. reduction, according to the amount of the accounts. The charge for electricity for motive power and heating purposes was, however, only 1½d. per unit., also subject to discount. If the Company were able to supply gas at a little over cost price it would pay. Seeing that the Corporation had come on the ratepayers to the extent of £13,904 to make up the deficit on the electrical undertaking, it was a little hard that they should oppose the Gas Company. The Company desired to be placed in the position of being able to compete with the Corporation on equal terms. Dealing with the petition, Counsel said that it was not in the interests of the Company to raise capital unnecessarily; and the capital powers now sought would not keep them out of Parliament an unreasonable time. In conclusion, he alluded to the expense of promoting Bills in Parliament, and said it was a serious matter to put £4000 or £5000 of dead capital on a Company, as it, after all, had to come out of the pockets of the consumer. Although he had a high regard for many members of his profession, it was the lawyers who carried away what was called the "swag." If the Company were not relieved of the difficulty of having to take the lowest price charged to any private consumer as the basis of charge to the Corporation, they would be in the anomalous position of being able to supply gas for purposes other than lighting at a low price in other parts of their area, while being obliged to refuse the same advantage to consumers within the boundaries of the old borough.

Mr. J. W. Stone Dix, J.P., Alderman of the City and County of Bristol and Chairman of the Bristol Gas Company since 1890, examined by Mr. Pollock, gave evidence bearing out the opening statement of Counsel. He thought that what the Company were now asking for would not keep them out of Parliament so long as ten years. They were simply seeking to be put in the position of commercial people who ought to supply a demand which they found had arisen. At present, the Company were competing with the Corporation for light with their hands tied behind them; while the Corporation could do as they liked, and did it pretty freely.

Friday, June 16.

Mr. Dix was to-day cross-examined by Mr. Moon. He said that, as the Company were not under the sliding-scale as to dividends, the most they could ever pay was 5 per cent. on the split capital. The number of

meters and stoves supplied had increased enormously. In 1896, the stoves numbered 4236, in 1897 4351, in 1898 7155, and up to the present time 9359. The Company had therefore had an increase of 2204 during the last few months. Any profit made in consequence of the alteration or repeal of the clause in the 1853 Act, which prevented the Company from supplying gas at a low price for motive purposes, would not be for the benefit of the Company, but of the consumers. The Company were not a philanthropic body; but it was certainly to their interest to maintain their position and meet the demands of their customers. Customers of the Company were constantly saying: "If you cannot give us gas for motive power at a reasonable price, we must take electricity." Gas for motive power was at present supplied at the same charge as for lighting purposes. Witness admitted that the provisions enabling the Company to supply dynamos and appliances for electric lighting originally in the Bill had been struck out by the House of Lords. It was a matter of importance to the Company that they should be permitted to compete with the Corporation of Bristol for purposes for which both gas and electricity were usable. Whatever was the real object of the Bill, the consumer would get the benefit of any advantage arising under it. The Company had power to compete with the Corporation now for motive purposes, if anyone liked to put up his own dynamos.

Re-examined by Mr. Pollock, witness said the appearance of the Corporation as a trading body dated from the opening of their works in 1893; and it was not possible for the Company, when they came to Parliament in 1891, to know what was intended by the Corporation. His idea was that the Corporation could come upon the Company to charge the same price for public lighting as that charged to any consumer, whether inside or outside the old borough limits. The slot meters were hired out by the Company themselves, and not by a separate concern.

By Sir W. Gurdon: The agitation about the payment of the 10 per cent. dividend had led to a strike which was most disastrous to the Company; and that was the reason the Company came to Parliament for the conversion of their stock. People could not see that the purchaser of shares under the auction clauses did not really get 10 per cent.

Mr. Moon pointed out that the conversion also enabled the Company to double their reserve fund; and it was to this that the Corporation objected in 1891.

Mr. Pollock: In 1891 you said we ought to lower the initial price, and asked for a number of other things, every one of which both Houses refused to give.

In reply to the Chairman, the witness said that twenty years ago £100 of stock was worth nearly £200; but owing to the decrease in the value of money, the shares were not really worth more now than they were then.

Mr. John Phillips, Secretary of the Company, said he anticipated a large increase in the number of stoves required for heating and cooking purposes in the future. An estimated expenditure of £120,000 for meters and stoves in the next ten years was, he considered, a very moderate calculation. While in 1898 the Company spent £13,459 under this head, up to the end of May this year they had already received orders for stoves to the value of £9240; and he believed that at the end of the year the Company would have spent something like £15,000 or more. He gave statistics showing that the number of stoves let out on hire had increased from 1889 in 1892 to 9357 at the end of May, 1899. The enormous leap from 4851 in 1897 to 7155 in 1898, was due to the Company reducing the price in the latter year. The Corporation electricity had displaced 599 lamps of the Company, who had lost by the action £2931 per annum. Counsel was continuing to further examine witness on matters of detail, when the Chairman asked whether there was much else in dispute except the vexatious clause compelling the Company to supply the Corporation at the lowest rate charged to any private consumer.

Mr. Frere said the opponents of the Bill in the other House contended that the public lighting was very profitable. The object of his examination was to show that the public lamps were not so profitable after all.

Witness (continuing) gave figures showing that the comparative returns were 8d. per yard of main from the Corporation, as against 6s. 5d. from the private consumer.

In cross-examination by Mr. Fitzgerald, witness admitted that the consumption of gas for public lighting had increased even since the introduction of the electric light. He was also cross-examined to show that it was in the discretion of the Company whether or not they complied with the request of the Corporation to lay a main in a certain place. The Company had, he said, very rarely exercised this discretion; and he thought the discretionary power only applied to the old area. It was not possible, either in the old or the extended area, for the Company to reduce their price to private consumers without bringing themselves under the obligation to reduce the rates also to the Corporation. The profits they hoped to get from the supply for motive power would enable them to make a general reduction all round to their customers, including the Corporation.

Mr. Corbet Woodall gave evidence as to the growth of the Company and the necessity for further capital powers. There was, he said, a falling off in the Company's supply of about 4 per cent. in 1893, chiefly owing to the substitution of the electric light for gas in the public lamps. He thought the Company should provide for at least 4 per cent. per annum compound increase, seeing how the demand for gas for cooking and heating purposes was advancing. The plums of the lighting pudding —such as the railway stations, theatres, and the large shops—were being taken away from the gas companies by the competition of the electric light; and the loss had to be made up by the gas companies providing for the demand for gas, not only for cooking and heating, but for power purposes. The newer circumstances, however, involved a greater capital outlay than the old. More capital was required in providing prepayment meters and fittings to several small consumers to earn the same return as was received from one large consumer in former times. He calculated that nearly £350 of capital per million cubic feet of gas sold had to be provided to meet the additional cost of obtaining consumers for a million cubic feet under the altered circumstances. Every gas company ought to look ahead for at least fifteen years; and assuming that £600 per million cubic feet was spent, the Company would require £476,400 for the increase of ten years in the future. Assuming the new capital would be sold at a premium of 20 per cent., the Bill authorized the raising of about £420,000, which, in his opinion, was not an extravagant amount for the Company to ask for. It was very important that a company should be enabled to supply at a low rate, for he had heard of cases where important manufactures had been established in certain towns simply because gas was cheap there. As to the reference in the petition to the reserve fund, it seemed to him that the object of a reserve fund was to secure the property of the owners, and therefore the reserve fund should increase with the increasing value of the undertaking. During from six to eight months of the year, at least two-thirds of the apparatus of a gas company was constantly idle. If permission to supply gas for motive power were given, the outlay of capital on works would be very much more remunerative. Even if the demand for gas for lighting purposes were ultimately shut out altogether, he believed there were many large manufacturers in the outer districts of the Company's area who would be glad to take gas for power purposes, if they were given the opportunity. If a consumer of electric light chose to obtain a supply of electricity by the use of a gas-engine, he believed a supply could be obtained for (say) 200 lamps at about 3d. per unit. In his opinion, there was nothing unfair in asking the Corporation to consent to a modification of the Act of 1853, having in view the totally altered conditions of gas supply.

Cross-examined by Mr. Fitzgerald, witness admitted that the sliding-scale had had the effect of abolishing differential rates. He would not dispute that there was no large town where the price for other than lighting purposes was lower than the charge for lighting; but there was no other large town, he contended, in the exceptional position of Bristol. He did not know of any town where the corporation were proposing to go in for the supply of electric motive power at a charge so low as compared with the charge for lighting. In revision of the figure given by him in the other House, he now said that the price at which the Company could supply without making a loss was 1s. 10d.—not 2s.—per 1000 cubic feet; the cost of capital under the new Bill being about 5d. per 1000 cubic feet, as against 8d., the present cost.

Re-examined by Mr. Pollock, witness said he thought that if the supply of electricity was in other hands the Corporation would not oppose the modification the Company desired in their Bill.

By Sir Leonard Lyell: The Company could afford to cultivate new business at 3d. less per 1000 cubic feet, although they could not at present afford to reduce their charge to existing consumers. It was only possible to secure the business proposed by supplying gas at a cheap rate.

The Chairman asked whether witness could give the relative cost of gas and electricity per unit or foot. He had often made the inquiry, but had never been able to get a satisfactory comparison.

In reply, witness said that the question was an extremely difficult one to answer, because the amount of light generated from gas varied so enormously according to the burner used. A Welsbach incandescent burner, with 2½ cubic feet of gas burnt through it, gave an amount of light equal to a Board of Trade unit of electricity. At 2s. 2d. per 1000 cubic feet for gas, as against 5d. per Board of Trade unit for electricity, the electric light would be about double the price of gas.

This closed the evidence for the promoters.

Mr. Thomas Newbigging, examined on behalf of the Corporation, said he had looked into the proposals of the Bill with regard to increase of capital, and considered the amount excessive. He detailed the figures on which he based his calculation, and said he thought the proposal to repeal the bargain entered into for the supply of the public lamps was manifestly unfair. The Corporation were the Company's largest consumers; and he considered they ought to be supplied at as low a rate as any of the private consumers. From an analysis of the Company's accounts, he found that the total receipts per 1000 cubic feet of gas sold amounted to 36·42d.; and the total payments on account of the manufacture and distribution per 1000 cubic feet were 27·92d.—leaving 8·50d. as the gross profit on every 1000 cubic feet of gas sold. After paying dividend on capital and other charges, this left, at the present price, only 0·1d. The Company therefore could not possibly pay the working expenses and the maximum dividend if they reduced the price; and the loss entailed by supplying special consumers with gas at a low rate would have to be made up by increasing the price to other consumers. Public lighting, taking gas seven nights a week, and involving no supply and inspection of meters, was more remunerative than private lighting for shops, &c. There could be no comparison between the manufacture of gas and electric light, for a gas company could go on making their gas during the whole 24 hours, and store it for use at night. There was therefore not the same necessity for a day-load as there was in the manufacture of electricity.

In cross-examination by Mr. Pollock, witness said that £400 per million cubic feet was the proper amount of capital expenditure in gas undertakings. He admitted that when he visited the Stapleton works he stayed only about half-an-hour, but said this was quite long enough to enable him to get all the particulars he required.

Monday, June 19.

Mr. Newbigging, re-called, said that the quantity of gas yielded per ton of coal carbonized by the Company was over 9000 cubic feet, and not over 10,000 feet, as he had stated. His calculation was made on the basis that the coal produced 9142 cubic feet per ton; and on this basis, and taking into consideration the number of existing mouthpieces, he contended that the Company had manufacturing plant 44 per cent. in excess of their requirements.

In cross-examination by Mr. Frere, witness admitted that he did not know the number of retorts used to produce the maximum make. He could not tell how many retorts were actually used in producing the average over the year of 9142 cubic feet per mouthpiece; but he contended that, where there was an excess margin of producing plant, nothing tended more to indifferent working, because the retorts were not put upon their mettle. He did not know that when the maximum make was attained there were only 149 retorts to spare, or 16 per cent. of excess power. The actual number of retorts used did not matter. What he said was that they could, if properly worked, attain the production he had estimated. It was no reflection on the Manager to say that; but the Directors were not wise in having an unnecessarily large margin of producing plant, as it tended towards indifferent working. He admitted he had no knowledge of the capacity of the condensers, the scrubber, the purifiers, or the gasholders; but he had allowed £45,875 as the sum to be expended on apparatus other than retorts during the next ten years.

Mr. Worsley Taylor then intimated that he did not propose to call further witnesses, unless anything occurred to the Committee on which they would like to hear further evidence.

Mr. Frere asked to be allowed to put in a petition from certain consumers in favour of the Company.

Mr. Worsley Taylor objected on the ground that no witness had been called to prove that there was a public feeling in favour of the Company obtaining the powers asked for; and he could not cross-examine a petition.

The Committee upheld the objection.

Mr. Worsley Taylor then addressed the Committee on behalf of the Corporation. He said the two points which the Committee had to consider were what should be the amount of new capital authorized under the Bill, and whether they should sanction clause 19 involving an alteration in the bargain of 1853. The Corporation of Bristol had never desired to hamper the Company in any way. It was perfectly right that the Company should have a reasonable amount of new capital. But Parliament had never given to concerns of this kind such an amount of capital as would enable them to keep away from Parliament an undue time. In gas lighting, and everything else, circumstances were constantly changing; and therefore, subject to the concessions granted to them when they came to Parliament, Parliament had always been careful to keep control over such companies as a matter of public policy. Even if the Corporation of Bristol had not been appearing, he was certain the Committee would have exercised some discretion as to the amount of capital to be allowed. As a result of the passing of the Bill, the Company would have capital powers to the amount of £520,000. If this amount would carry them on for more than 10 or 12 years, then, on the evidence of the promoters themselves, it was too much. Taking the 46 years of the Company's existence, he found that the annual capital expenditure had been about £26,000. If they had been able to start their works, carry out all their extensions, and still have in 1899 a large margin of producing and storage power on an expenditure of £26,000 a year, then it was not hard on the Company to multiply that figure by 10 and say that the amount of £260,000 was ample to meet their requirements until they came to Parliament again in ten or twelve years' time. Curiously enough, his own calculation substantially agreed with the more elaborate calculations of Mr. Newbigging. He contended that the evidence as to the excess plant was absolutely untouched, and was indeed corroborated by the evidence of Mr. Corbet Woodall. Mr. Woodall's calculation was based on an absolute fallacy; inasmuch as in taking the capital expenditure of £600 per million cubic feet of gas produced, he apparently forgot, in dividing the capital expended in order to arrive at that figure, that the capital expenditure included the initial and very heavy costs of buying land, &c., and the construction of works. The Company were now asking this large capital of £520,000 for the mere extension of their business. Turning then to the disputed clause 19, Counsel said if the Company wished to reduce their price to the ordinary consumers they could do so now. The first part of the section was therefore absolutely unnecessary. In asking in the second part of the section to be allowed to reduce the price to ordinary consumers without having also to reduce the charge for the public lamps, the Company were seeking to repeal the parliamentary bargain entered into between them and the Corporation in 1853. By coming to Parliament in 1853, the two Companies then amalgamated derived certain advantages which enured to the benefit of their shareholders and consumers. The bargain which the Corporation then made enured to the benefit of the whole community, because everybody benefited by the public lighting being obtained at a reasonable cost. In the other House, the Corporation had made a rather rash admission in saying that the provision as to the charge for public lighting was exceptional. So far from this being the case, it had been found that there was precedent after precedent for such a clause in Gas Acts. The Act of 1853 was ancient history. He was prepared to show that in modern history Parliament had sanctioned stronger clauses in favour of the general community than anything in the Act of 1853. Starting with 1898, he was prepared to submit 92 precedents going back so far as 1852. The Company talked about gas for motive power and cooking and heating purposes being something new, and laid stress on the competition of electricity in the hands of the Corporation as a reason why they should be given the powers they sought. But in 1898, the last of the precedents he wished to submit, all these things were in existence and perfectly well known. Therefore, if corporations asked for such clauses, and obtained them, either the companies assented to them, knowing all these facts, or Parliament put the clauses upon them, knowing all the facts. Counsel then read sections from the Thanet Gas Act, 1898, showing that the price charged for the lighting of the public lamps was 5 per cent. less than the lowest charge for gas to private consumers; the Newcastle and Gateshead Act, 1896, providing a special discount of 2½ per cent. on the lowest charge to private consumers if the lamps were lighted all the year round; the Scarborough Gas Act, 1895, providing that the Company should supply the public lamps at a reduction upon the gross price charged to private consumers of 20 per cent. on quantities between 10 and 15 million cubic feet, and 25 per cent. on quantities above 15 millions. He also mentioned the Harrow Act as embodying a similar clause. In a number of the cases, the supply of electricity was in the hands of the authorities. If the Bristol Company wished to tear up a parliamentary bargain, they must show strong public advantage in favour of it. Not one member of the public had been called in support of the Company's proposal. The Company, however, were doing so well that they were still able to charge 2s. 4d. per 1000 cubic feet to private consumers, or 2d. per 1000 feet more than they need do. Counsel maintained that the real object of the Company was to compete with the Corporation electricity, and to do by a side-wind what a Committee of the other House said they should not do directly. If the Company contemplated giving a cheaper supply to certain consumers, why should they not give it to their best customer, the Corporation, who represented the community? Although the Company said they intended to supply gas for motive purposes at a profit, there was nothing to prevent them, in order to compete with the electric light, supplying at a loss. If this happened, the burden would fall on the community as users of gas for public lighting, and on the individual consumer of gas for lighting purposes. The lighting consumers had made the Company what it was; and it was therefore not fair to throw on them the risks attending this new service. The Company had had three opportunities since electric lighting came into general use of suggesting this competition when they came to Parliament, but had failed to do so.

In reply on the whole case, Mr. Balfour Browne said he could not help thinking there was a very important principle in the Bill, and that if the Committee passed it they would not be breaking a bond, but would be doing something which was unquestionably in the interests of the Company, and also in the interests of the public. On the question of capital, he urged that the whole object of gas legislation was to make every penny of capital earning capital. If the Committee decided that a company were to come to Parliament every four or five years, they would be hanging an unprofitable expenditure round the neck of the Company, to the detriment of the consumers of gas. He pointed out that the average of capital expenditure was made up of the highest and the lowest. In some years the capital expenditure was £50,000. The £420,000 now asked was to provide the capital expenditure at an average of £35,000 a year for the next 12 years, which, he contended, was a reasonable time for the Company to be allowed to keep away from Parliament. It would be wrong for Parliament to insist upon the Company coming again for fresh capital powers almost immediately. The interest of the existing shareholders was not to overspend on capital account, but to go on earning their dividend. Turning to the evidence of Mr. Newbigging, Counsel said his testimony was rash and ill-founded. On the strength of merely a quarter-of-an-hour's visit to a gas-works, managed by an exceedingly capable and able man, Mr. Newbigging had said the management was faulty. Fault was found with the Company because they only got 4500 cubic feet per mouthpiece, while they might get 6000 cubic feet. It was true they could get the latter amount if they used more expensive coal; but in the exercise of their discretion the Directors used the coal of the district, and were content with the smaller output. Mr. Newbigging's calculation of the surplus capacity was absolutely ridiculous. As the result of the Company's working, they were supplying gas to the consumers very cheaply; and this could not be done if a more expensive coal were used. Dealing with clause 19 of the Bill, he contended it did not involve a repeal of a parliamentary bargain at all. When the agreement was entered into, both parties had in mind only the supply of gas for lighting. Nobody ever thought that gas would be supplied for power purposes. It was only recently that gas companies had looked around to see how they could replace their diminishing consumption with regard to light by an increased consumption in regard to power. Therefore the British Company were quite justified in sticking to the bargain made in 1853, and saying they would supply gas to the Corporation now for lighting purposes at the lowest price at which it was supplied to a private consumer using it for the same purpose. He ventured to say that the position taken up by the Corporation in trying to prevent the Gas Company competing with them for power purposes was an entirely improper one. It was to the advantage of the consumers that they should have two strings to their bow; and the attitude of the Corporation was wrong in principle, and contrary to public policy which regulated the action of Parliament in such matters. As to the precedents put in by Mr. Worsley Taylor, if he had had an opportunity of cross-examining that gentleman, he could show he knew nothing about them. Mr. Worsley Taylor had said he cared nothing about the circumstances; but he (Mr. Balfour Browne) cared everything about the circumstances. In regard to none of them was there a contest over the question. In most cases it was a matter of arrangement, as in the cases of Derby and Newcastle and Gateshead. With regard to the Thanet Gas Act, the whole fight turned upon the question of works; and he did not remember electricity being mentioned from beginning to end in the Harrow and Stanmore case. But in not one of them was the circumstance existing of electric competition at a very low price, as was the case in Bristol. The equities made for competition against monopoly, and in this case the equities made for the Company. In quite recent times, the Corporation proposed to supply electricity at 1½d. per Board of Trade unit, which would practically make it impossible for the Company to compete if they were not given the power they asked. Was that not an exceptional circumstance? The Corporation had drawn upon the rates for the purposes of their electrical undertaking; and it was one of the hardships of the Company that they had to contribute to rates which were used for the purpose of competing with them. The Company had no intention of competing with the Corporation for electric light. They had, however, under section 14 of the Act of 1891, power to supply gas for all purposes; the absolute right to supply gas for all or any purposes they chose. It was because Lord Derby in the other House pointed out the very large powers the Company had that they were willing to take out the word "dynamo." While the Company could never really compete successfully with the Corporation for power to be turned into electric light, he saw no reason why the Company should be prevented from supplying power for such a purpose. Mr. Preece, in the other House, had said he was prepared to admit that if the Company were to confine their operations to supplying gas-motors with gas for various appliances, then they should be allowed reasonable and fair means of conducting their business. No wonder the Corporation had not called that gentleman again. As to the contention that the Corporation were the largest consumers, and therefore the best customers, of the Company, Counsel pointed out that the Corporation supply was really an aggregation of small consumers; the Company were supplying the Corporation at several thousand places. The Corporation could not be considered as one great consumer taking a large quantity of gas at one place. Yet they wanted to be put on better terms than anybody else. Although not in the interests of the Electric Lighting Committee of the Corporation, it was in the interests of the Corporation and the city of Bristol that the Company should be allowed the power asked. If the Company made a small profit on the motive supply, the lighting consumers would get their gas cheaper; and among the benefited consumers would be the Corporation themselves. If the Committee rejected clause 19, the result would be that they would take away the customers from the Gas Company, and deprive them of the power they at present had to supply gas for motive purposes, and thereby make gas more expensive for everybody in Bristol. The Corporation supplied electricity for power at 1½d. per Board of Trade unit. They would be unable to do this were it not for the 5d. per unit and the two-thirds of 5d. charged to the lighting consumers. There was no big authority in this country

who were supplying electricity all round at 1¼d. per unit; such a charge could not stand alone. The Company desired to be allowed to make differential charges also. If the Company were allowed to supply a day demand for gas, it would double the utility of the plant, and double its earning power.

The room was then cleared; and on the public being re-admitted,

The Chairman announced that the Committee had decided that the preamble was proved; but that section 32 of the Act of 1853 should not be repealed, and that the recommendations of the report of the Home Secretary with regard to the Bill should be embodied in the Bill.

The report of the Home Secretary to which the Chairman alluded was as follows:—

The first sub-section of clause 26 enables the Company to fix the position of the gas-meter in any house. The secretary of State submits that if the principle of this clause is admitted, it should apply to existing meters only, if the work is done at the expense of the Company, for whose benefit the alteration in the meters is made. The mere change of tenancy of a house does not appear to be a matter which entitles the Company to impose for its own benefit a charge with respect to a non-existing meter, whether that charge falls on the outgoing or on the incoming tenant. The Secretary of State recommends that the words at the end of the sub-section, "except upon a change of occupancy of the premises in or upon which such meter is now placed," should be omitted.

Sub-section 2 gives the Company a roving power at any time to require an alteration of the pipes and fittings connecting their mains with the consumer's meter. In the opinion of the Secretary of State, if the Company require any alterations in existing fittings these alterations should be made at their own expense, and not at that of the consumers.

As regards future pipes and fittings, the requirements of the Company should be stated and enforced at the time that pipes and fittings are being laid—not at any time the Company thinks fit to interfere. For this purpose, the provisions of section 34 of the Halifax Corporation Act, 1893, should be adopted.

The proposal of the Company that they should be made the judge of what is a satisfactory supply of gas to a consumer, and that they should at any time have power to require him to lay down larger pipes, appears to the Secretary of State to be specially objectionable, and should not, in his opinion, be entertained.

The right of appeal to Justices in Petty Sessions would in the case of a poor man be no protection against oppressive action on the part of the Company, as he could not avail himself of it without legal assistance.

Clauses were then gone through. The disputed portion of clause 19 was struck out.

On the first of the recommendations of the Home Secretary, Mr. John Phillips, the Secretary, was re-called to show that at present the meters were in a great number of cases placed outside the houses, in the gardens. It was therefore in the interests of the consumers themselves that the meters should be placed inside, so as to avoid any leakage which might occur in the pipe between the meter and the burner being charged to them. On the other hand, it was only fair that the consumer should bear the costs of a proper pipe being laid in his garden. He gave instances of where the gas-pipe had been tapped and the gas used before it reached the meter in some of the houses.

At the conclusion of Mr. Phillips's evidence, the Committee decided not to enforce the recommendation of the Home Secretary on this particular point.

Other clauses having been gone through, the Bill as amended was ordered to be reported to the House.

THE CONTEST FOR THE DERWENT WATERSHED.

The Committee's Report.

Sir John Brunner, the Chairman of the Committee who were recently engaged in the consideration of the Bills promoted by the Derby, Leicester, and Sheffield Corporations to acquire the waters of the River Derwent, the proceedings on which were reported in previous issues, presented to the House of Commons a report, in which he stated that, in the case of the three Bills, the Committee had, pursuant to the instruction of the House of the 2nd inst., consolidated them into one Bill—"To authorize the construction of works for impounding and distributing the waters of the Rivers Derwent and Ashop and their tributaries, and to constitute a Joint Board representative of the Corporations of Derby, Leicester, Nottingham, and Sheffield, and of the County Council of Derbyshire, for the purposes of such construction, and to confer further powers in relation to the supply of water on the Corporations and the County Council, and for other purposes." He further stated that the Committee had provided in the Consolidated Bill for the construction of a Joint Board representative of the Corporations of Derby, Leicester, Sheffield, and Nottingham, and of the County Council of Derbyshire; and that the water to be impounded and distributed by the Bill should be allocated among these authorities in the proportions specified in the Bill. In pursuance of Standing Orders, the Committee had inquired into the expediency of the provisions made in the Bill for compensation in water, and had made provision for a continuous flow, throughout the 24 hours of every day, of the water given in compensation. Reports from the Local Government Board had been laid before the Committee and considered by them; and the Committee were of opinion that the amendments they had made in the Consolidated Bill sufficiently met the points raised by the Board, having regard to the special circumstances of the case. Sir John further reported that the Committee had examined the allegations contained in the preambles of the three Bills, had consolidated these preambles, and had amended the same so as to make them consistent with the provisions of the Consolidated Bill as passed; and they found the preamble so consolidated and amended to be true, and had gone through the Bill and made amendments therein. The Bill came up for consideration in the House last Friday, when, the Queen's consent on behalf of the Duchy of Lancaster having been signified, Dr. Farquharson moved the suspension of certain Standing Orders so as to allow of the Bill being read the third time. This was done, and the Bill passed. It will now go up to the Lords, where any objections which have been reserved will be considered by a Select Committee.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Wednesday, June 21.

(*Before the* Master of the Rolls, *Sir* F. Jeune, and *Lord Justice* Romer.

Jordeson v. Sutton, Southcoates, and Drypool Gas Company.

Mr. Haldane, Q.C., on behalf of the defendants, applied for a stay of execution pending an appeal to the House of Lords. He said the plaintiff had put in execution, and recovered the damages—viz., £340. Of this the defendants did not complain; though they did object to pay the costs unless they obtained an undertaking from the Solicitor to refund in the event of the decision being reversed. The costs amounted to £1800; and if they paid them, there was no security that they would get them back, as the evidence proved that the property in question was mortgaged for more than its full value, and had been allowed to fall into disrepair. The plaintiff said he had not repaired the property, as he had been advised that it would be imprudent to do so until the land had settled.

Mr. D. Pollock said there was no ground for the charge of insolvency against the plaintiff; and he declined to give any undertaking.

Lord Justice Romer thought it could not be said that the appeal was a frivolous one.

The Master of the Rolls intimated that, if plaintiff did not give the usual undertaking to return, the Court would grant a stay.

Mr. Pollock said the plaintiff had no wish to be paid the costs pending the appeal; and he should be quite willing to allow the defendants to keep the amount, provided they agreed to pay interest at the rate of 4 per cent. from the date of the judgment.

Mr. Haldane said he had no objection to do this; and

Their Lordships assented to the proposal.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Tuesday, June 20.

(*Before Mr. Justice* Bigham.)

The Best Incandescent Gas Share Syndicate, Limited, v. Foster.

This was an action to recover from Mr. H. Seymour Foster the sum of £165 odd, alleged to be due under an agreement of November, 1897. The defendant pleaded that he had been induced to enter into the agreement by misrepresentations.

Mr. Astbury, Q.C., and Mr. Tindal Atkinson appeared for the plaintiffs; Mr. Macaskie and Mr. A. J. Walter represented the defendant.

Mr. Astbury said the action was brought to recover the costs incurred by plaintiffs, in a threats action instituted by them against the Welsbach Company, and also a sum paid for costs in an infringement action brought by the Welsbach Company against the Best Company. The plaintiffs were a small Syndicate formed for the purpose of acquiring and floating certain patents connected with incandescent gas lighting; and in March, 1897, Mr. Foster was asked whether he would assist in promoting a Company. He said he would do so if he got £50,000 out of it; and he entered into an agreement with the Syndicate to form a Company to buy the patents for £100,000. In consideration of the large amount to be paid to Mr. Foster—viz., £50,000—he undertook to discharge the preliminary expenses. It appeared that the Welsbach Company, as soon as they heard of the new mantle, began to warn persons against purchasing infringements; and Mr. Foster arranged that the Best Company should institute a threats action, to which the Welsbach people replied by commencing an action for an injunction to restrain infringement. The sum now claimed was for costs already paid in respect of these actions. The patent belonging to the Syndicate was that known as Crocker's for manufacturing mantles out of such rare earths as ytterbium, thorium, and scandium; and the defendant, although he now alleged that the patent was comparatively worthless, made every inquiry, and satisfied himself upon every point, before entering into the agreement.

Mr. *A. E. Allen*, the Secretary of the plaintiff Syndicate, was called, and proved that the amount sought to be recovered had been paid to their Solicitors. In cross-examination, he said they had a few dozen mantles which were made in 1896 according to Crocker's patent.

Mr. Macaskie said the short question really was whether or not Mr. Foster was induced to enter into the agreement by means of misrepresentation. It appeared that Mr. Foster was introduced early in 1897 to a Mr. Rayner, a Patent Agent, who proposed that he should take up the patent; assuring him that it was a valuable one, and that there was no question of its infringing the Welsbach patents. In support of this statement, he produced the reports of eminent scientific persons, and the opinions of several Counsel, that the earths mentioned by Crocker were not covered by the Welsbach patents. After some negotiation, the agreement in question was entered into. He should prove that pure scandium could not be bought in any shop in the world; and that Mr. Crocker had, when examined before Mr. Justice Romer, practically admitted this. A report made by Professor Crookes in October, 1896, was to the effect that the chemical bodies claimed by Crocker were different to those used by other patentees; but Mr. Foster not being satisfied that the mantles would burn a sufficient number of hours, Mr. Rayner had one of them tested by Professor Lewes. The result of this test was perfectly satisfactory; but owing to certain information which came to his knowledge, Mr. Foster had the ashes of this mantle analyzed, when it was found not to contain the oxides mentioned in Crocker's specification, but those named in the Welsbach patent.

His Lordship: What is the fraudulent misrepresentation on which you rely; and where is the warranty to be found?

Mr. Macaskie: In the statement made by Rayner to Mr. Foster, and in the documents handed to him.

His Lordship: What do you say the warranty amounts to?

Mr. Macaskie: That the patent was valid; that the mantles could be supplied as an article of commerce; and that the earths in Crocker's patent were easily procurable in a pure state in such quantities, and at such prices, as rendered them commercially available. I further say that

the supply of mantles to my client was a condition precedent to his liability under the agreement. Although he frequently applied for mantles, he was not able to obtain them.

Mr. *H. S. Foster* was then called, and gave evidence in support of his case. In cross-examination, he said he suggested that Rayner was aware that the mantles were in reality made with the earths used by the Welsbach Company, and were consequently infringements.

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Mr. *Horatio Ballantyne* deposed that he had analyzed the ash of the mantle received from Professor Lewes, and failed to discover any ytterbium, thorium, or scandium. Substantially, the ash disclosed only the earths used by the Welsbach Company.

Cross-examined: The total weight of the ash was 4¼ grains, or less than half the weight of a mantle. He had frequently given evidence on behalf of the Welsbach Company. Thorium was the base of the mantle, scandium being claimed as the light-producing metal; and the specification provided for from 1 to 2 per cent. of this element. Very little was known about ytterbium, thorium, or scandium. He had never previously analyzed a mantle for the purpose of discovering scandium.

Re-examined: There was no such thing in commerce as scandium. Had 1 or 2 per cent. of scandium been in the ash, he could not have failed to detect it.

Mr. *J. A. Williamson*, an Analytical Chemist, said that thorium was a well-known earth; but he was not acquainted with scandium or the other two earths mentioned in Crocker's specification. He could find no trace of scandium in commerce.

Mr. MACASKIE said that was the case on behalf of the defendant.

Mr. ASTBURY asked for, and obtained, leave to call rebutting evidence.

Mr. *G. H. Rayner* produced two invoices from Messrs. Kendall and Son for ytterbium and scandium, from which the mantles in question had been made. In cross-examination, witness said the scandium was delivered to him in Chancery Lane; and he took it to Crocker, and saw him make the mantles. He objected to Mr. Foster having any mantles as he thought he might hand them over to the Welsbach Company. He had not found out that it was difficult to get pure scandium. He would not say that it could be obtained now.

Mr. *S. H. Crocker* deposed that he made the mantles which were sent to Professor Lewes from materials supplied by Mr. Rayner. The burnt mantle was different in appearance from the Welsbach mantle.

Cross-examined: He was not a chemist. Mr. Rayner drew up the specification; but witness was the inventor. At the time the patent was taken out he was engaged manufacturing tools to make paper fasteners. He also made parts of cycles.

His LORDSHIP said he was satisfied that witness had not invented this patent.

Mr. *C. H. Desch*, a Chemist in the employ of Messrs. Kendall and Son, said that in 1896 they received an order from Mr. Rayner for scandium and ytterbium. If scandium contained any impurity, it could only be ytterbium. So far as he could satisfy himself, the scandium supplied was either pure or it contained a slight percentage of ytterbium.

Cross-examined: He carried out the process for extracting the scandium; and it was guaranteed to be as pure as it could be obtained. It was very difficult to get it pure. In commerce, there were no such things known as scandium, thorium, or ytterbium. It was possible, at the cost of a great amount of labour, to get pure scandium in minute quantities. It was very likely that he told Mr. Rayner he could not guarantee its absolute purity.

Re-examined: Mr. Rayner told them to get it as pure as they could. Mr. Foster wrote to them to know whether the three rare earths were obtainable in any quantity for commercial use. If people were prepared to give a sufficiently large order, he could supply scandium.

This completed the evidence.

Mr. MACASKIE submitted that the case had failed, and defendant was entitled to be relieved of the contract on the ground of fraudulent misrepresentation, or, in the alternative, to damages commensurate with the amount recovered under the agreement.

His LORDSHIP, in giving judgment, said the action was brought by the plaintiffs upon an agreement dated Nov. 25, 1897, by which the defendant promised, among other things, that he would provide the money that might be required by the plaintiffs in defending an action which it was at that time clear might be brought by the Incandescent Gaslight Company against the plaintiffs for infringement of the Welsbach patents. There was no dispute about the amount of liability; nor was any answer put forward to the claim except one—viz., that the agreement was obtained by the fraud of the plaintiffs, or that, if not, there was a warranty given that certain representations were true, and that the damages for breach of this warranty would be co-extensive with the amount claimed in the action. Now the facts were these: The Incandescent Gaslight Company, in, and prior to, the year 1896, owned certain patents for the making of mantles with certain earths of a more or less rare description. In or about the year 1896, Mr. Crocker and Mr. Rayner put their heads together for the purpose of devising a means of making incandescent mantles with other earths than those used by the Incandescent Company. Having devised what they hoped might be a means of making mantles without infringing the Welsbach patents, they formed a Syndicate, in which Mr. Rayner took a considerable share of the capital. Not having much money, they approached Mr. Foster to finance them; and he agreed to do so. At that time the Incandescent Company had threatened persons who might use the mantles produced by the Syndicate with actions for infringement. These threats having been made, the Syndicate brought an action against the Incandescent Company to restrain them from continuing to make the threats. This action was pending at the time Mr. Foster signed the agreement sued upon; and one of the undertakings in the agreement which he entered into was that he would provide the monies which might be necessary to enable the Syndicate to prosecute the threats action to its termination. That action, however, after the agreement was signed, was stayed by an order of the Court; the Incandescent Company undertaking to bring an action against the Syndicate for infringement. Mr. Foster was to provide the Syndicate with the means of resisting this action; but he did not make himself liable to pay the costs which might be awarded to the Welsbach Company or any damages that they might recover. It was for money properly spent in the defence of the patent action that this action was brought. The first defence was that of fraud. Mr. Foster said Mr. Rayner represented to him that two if not more mantles had been made in accordance with the Crocker patent, and that these mantles were not infringements of the Welsbach patents. He said he had since discovered that the two mantles were not made in accordance with Crocker's patent, but with the Welsbach patents; and that Rayner knew this when the agreement was signed. One of the elements to be used in the making of the plaintiffs' mantles was a substance called scandium. Scandium was not one of the elements or materials used in the making of the Welsbach mantles; and no doubt Rayner honestly believed that mantles might be made with scandium without interfering with the Welsbach patent. Rayner procured some scandium, which he took to Crocker's shop, and there caused two mantles to be made, which he believed were in accordance with Crocker's specification and not infringements of the Welsbach patents. These two mantles he tested for something like 1000 hours, with results which appeared to him, at all events, to be satisfactory. All this took place before the agreement. In this state of things, the negotiations went on with Mr. Foster, who was trying to obtain a number of the mantles for the purpose of showing them to people who were likely to take up the scheme when at the proper time it was put before the public. He did not get the mantles he asked for. Various excuses were made as to why he could not have them. At a Board meeting held a few days before the agreement was signed, a complaint was made that the sample mantles had not been delivered, and the Board by a majority (Mr. Rayner dissenting) decided that he should have them. Did Mr. Rayner object from a dishonest motive or not? He (his Lordship) thought it was because he knew they were being threatened by the Incandescent Company, and he feared the mantles might get into the possession of that Company. What he said was: "I have done my best to make the mantles in accordance with Crocker's patent. I believe I have succeeded; but I could not be sure that the mantles do not contain impurities, and I could not be sure that the existence of those impurities might not be detected by the Incandescent Company, and used by them in the litigation." He to a certain extent sympathized with the reluctance which Rayner felt at the time to supply the mantles to anyone; and he came to the conclusion that there was no misrepresentation or fraud whatever before the agreement was entered into. Of course, it was necessary to see what took place afterwards, because that might throw light on what occurred before. Mr. Foster, in order to make out his defence of fraud, had thought proper to put himself into communication with the Welsbach Company. This was an act of disloyalty to the people whose interests he was, under the agreement, bound to serve; and he did not believe that he really suspected any fraud at all until he went to the Welsbach Company. Mr. Foster obtained the ashes of the two mantles which had been burnt for 1000 hours; and he placed one-half in the hands of Mr. Ballantyne, a chemist often employed by the Welsbach Company, and whose name was supplied to Mr. Foster by that Company. His Lordship was perfectly satisfied that Mr. Ballantyne made his experiments with care and skill; and that he had honestly and straightforwardly put the result of his experiments before the Court. The result was not a satisfactory analysis. The ash was about one-half the weight of a mantle; and he detected 0·85 per cent. of what he called a mixture of rare earths belonging to the cerium and yttrium group. Scandium belonged to the yttrium group; and according to Crocker's patent, there needed to be in the composition of a mantle not more than from 1 to 2 per cent. of scandium. There was in the ash very nearly 1 per cent. of the group named; and Mr. Ballantyne said that in the process of combustion, a portion of the component parts of the mantle were carried away by the action of the flame upon the mantle itself. Mr. Ballantyne further said that he did not think the 0·85 per cent. was to any large extent made up of traces of the ytterbium group; and therefore he came to the conclusion that the mantles constituted an infringement of the Welsbach patents. He (his Lordship) was very far from saying that the conclusion at which Mr. Ballantyne arrived was not an accurate one. It might be; but that was to be tried somewhere else. What he did say was that the test did not satisfy him that the material obtained by Mr. Rayner from Kendall and Son was not honestly used in the making of the mantles. Then it was said that Mr. Rayner told Mr. Foster the Syndicate had produced a perfect mantle which did not infringe the Welsbach patent. But Mr. Foster knew that this was merely an expression of opinion; and to say it deceived him was nonsense. If it had been absolutely true, and more than an expectation and hope, would Mr. Foster have got the large remuneration which he was to have? He knew he was taking the risk—and a large risk too. He knew of the threats action, and that the outcome of that would probably be an action for infringement. Then it was said that Mr. Rayner told Mr. Foster the Syndicate were quite ready to begin making the mantles; but it was perfectly clear he was told that there was a difficulty in getting the material, and not until there was a demand for the material in large quantities was it likely that people would go to the trouble of producing it. As Mr. Foster did not provide money for defending the infringement action, proceedings were taken against him in January, 1898; the plaintiffs claiming rescission of the agreement. Mr. Foster then insisted upon the agreement being carried out; his only defence being that the money had not been properly expended. The action was decided against Mr. Foster; and now further money being wanted, fraud was for the first time suggested. The charge of fraud was not made out; and it followed that there was no warranty of any kind. Judgment would therefore be given for the plaintiffs for the amount claimed, with costs.

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

Tuesday, June 20.

(*Before Mr. Justice* STIRLING.)

Windermere Gas and Water Company v. Crosthwaite.

His Lordship this morning delivered his reserved judgment in this case, which was reported in the "JOURNAL" for May 9, p. 1223. The plaintiffs asked for an injunction to restrain defendant from removing certain water-pipes on his land.

Justice STIRLING, after stating the facts of the case, said the question

he had first to consider was whether, under the circumstances, the plaintiffs had acquired, as they contended they had acquired, an easement in the defendant's lands. Inasmuch as the plaintiff Company in 1869 acquired nothing from the then owner of Grove's allotments, the owner remained entitled to the rights and privileges as riparian owner. No alteration took place till 1883 or 1884. The compulsory powers of the plaintiffs had then expired; and therefore any new rights must be by agreement between the Company and the owner. Such agreement was not embodied in any deed or written document; and the facts proved appeared to him to show that the pipes were laid down on the defendant's land with the consent of the then owner, but no easement had been granted by her. All that she said was that if she was put to no expense, and her tenant was satisfied, the plaintiff Company were at liberty to do as they desired. He thought the plaintiffs were licensees only of such interest as they had hitherto enjoyed, and that the defendant was entitled to put an end to the licence. He also thought the defendant retained the right of riparian proprietor, and might use the water of the stream for any purpose which did not inflict injury on other riparian owners, and might remove the pipes and let the water flow in an open stream. He could not, however—as against another riparian owner—sensibly diminish the flow of the water, or alter the character or quality of it. The plaintiffs were not shown to be riparian owners; but they had, under their statutory powers, impounded the water of the stream in a tank constructed on land of which they were not the owners. On the other hand, the right to a flow of water, and to the preservation of its quality, was not confined to riparian owners, but was recognized at law. As at present advised, he thought that, as against the plaintiffs, the defendant could neither obstruct the flow of the stream nor diminish its purity. The plaintiffs said two consequences were likely to follow the removal of the pipes by the defendant. In the first place, they said that the stream would be polluted by the soil and mud. According to the evidence of the plaintiffs, when the pipes were laid down in 1883 the natural bed of the stream was removed; and if the pipes were now removed, the present bed would be washed into the stream, and the water would be polluted until a new bed was formed. There was no evidence of the defendant to the contrary. It was obvious that such pollution might be prevented by taking proper precautions; and this the defendant offered to undertake to do. The other source of pollution was that arising from the cattle and sheep which fed on the allotments. It must be borne in mind by the defendant that a user, as riparian owner, which might be permissible on the banks of the Thames, might give rise to a cause of action on the stream in question. The decision as to who was to bear the costs of the action turned on what was the real issue between the plaintiffs and the defendant at its commencement. The plaintiffs distinctly claimed an easement of having the stream carried in pipes for ever; and it was impossible for the defendant to dispute the claim without insisting on his right to remove the pipes. The claim to the easement, in his Lordship's opinion, failed. Therefore, upon the defendant giving the undertaking that in the removal of the pipes he would exercise all necessary and proper precautions to prevent the pollution of the water by the soil or earth in the water course, there would be an order that the plaintiffs pay the costs of the action.

The Pollution of Streams by Gas Liquor.

The County Magistrates at High Wycombe had before them last Friday a prosecution by the Thames Conservancy of Mr. A. E. Reed, trading as Messrs. A. E. Reed and Co., paper makers, of Budge Row, E.C., for causing a quantity of "washing or other substance used in the making or supplying of gas," to flow from his mill at Wycombe Marsh into the River Wye, which runs through High Wycombe, and joins the Thames at Bourne End, contrary to the provisions of the Thames Conservancy Act, 1894. Mr. Bunting, Solicitor for the Conservancy, stated that on the morning of the 6th of May, one of the employees of Messrs. Reed and Co. emptied the contents of a tank into the stream; and as soon as the liquor entered the river he noticed that a number of fish rose to the surface dead. The Inspector of the Conservancy was afterwards sent for; and to him the employee admitted that the liquor had been allowed to run from the gasholder by order of the firm. The evidence of various witnesses showed that within a small area 33 splendid specimens of trout were found at once, and that the vessel had not been emptied for nearly a year, so that the liquor had assumed a very concentrated form of poison. Mr. Bunting did not press for a heavy penalty, but pointed out that the defendant must have known what the effect would be of emptying the stuff into the stream, as well as the penalty laid down in the Act, as cases of the kind had occurred in the locality. The Bench imposed a fine of £4, and 9s. 6d. costs.

The Acetylene Gas Industry in Italy.—According to the correspondent of the "Financial News," the shares of the Acetylene Gas Company of Rome have lately advanced very considerably in price. From their nominal value of 250 lire, they went up to more than 1100 lire, and closed a short time ago at 1040 lire. The writer says that, although the greatest portion of this advance was made on the strength of large profits realized on certain water-power concessions which the Acetylene Company had secured on very favourable terms, the fact nevertheless remains that the carbide production of the Company cannot meet the ever-increasing demand. He states that the Company have already sold all their future production for six months to come. These results have encouraged other capitalists to direct their attention to the new industry; and a fresh Acetylene Company has recently been started, while the agreement for the formation of another has been signed. The one formed is the Societa Piemontese per il Carburo di Calcio, &c., with a registered office in Turin and works in St. Marcel (Aosta). The capital is 2,500,000 lire, in 200 lire shares, and the chief promoters are banking firms of Turin. The shares have been warmly received on the bourses, and have been quoted at 50 per cent. premium. The other Company in the way of formation will have their offices in Milan, and works also in the valley of Aosta (Piedmont). The capital will be 4,000,000 lire; and it has been already subscribed in full by the promoters. Writing more recently, he said the shares of the Acetylene Gas Company had reacted to 970 lire; but they closed firm again at 1045 lire.

MISCELLANEOUS NEWS.

EDINBURGH AND LEITH GAS COMMISSIONERS.

The Annual Accounts.

The accounts of the Edinburgh and Leith Gas Commission for the year ending the 15th of May, have been issued by Mr. John S. Gibb, the Treasurer. They show the surplus on the year's working to be £58,245 4s. 7d. From this surplus there has been paid: For Edinburgh and Leith annuities, £33,208; for Edinburgh-Portobello gas annuities, £1145; amount transferred to the sinking fund in respect of annuities redeemed, £846; amount transferred to the sinking fund in respect of mortgages redeemed, £256; interest on mortgages, &c., £10,003; expense of mortgages, £268—together, £45,727. After meeting these charges, there remains a balance of £12,517, which, being added to the amount brought forward from the year 1897-8, after taking away contributions to the sinking funds and writing off £6000 from the suspense account, £18,639, makes the total sum at the credit of the profit and loss account £31,156. This is subject to the statutory minimum charges for the sinking funds, as follows: (1) For repayment of money borrowed, £2299; (2) for redemption of annuities, £7249—together, £9548, which, being deducted from the above sum, leaves a balance of £21,608, which may be dealt with at the discretion of the Commissioners in terms of their Act. The Treasurer adds that if the Commissioners should resolve not to avail themselves of their statutory power, to defer for five years contributing to the sinking fund for money borrowed in respect of the new works at Granton, the minimum contribution to the mortgage sinking fund would be £1322 more than the above, and the balance remaining to be dealt with would be correspondingly less. The cost of the Act for the new works at Granton has been £3430. It is worthy of consideration whether this should not be written off by the reserve fund of £3280; and the balance of £150, as well as £821, the expense of the disposition of the Granton property, charged against the balance carried forward, instead of being added to capital account.

Of a total authorized capital of £370,000, there have been redeemed annuities to the value of £10,114; reducing the annual payments of annuities from £35,200 to £34,256. Of a total borrowing power of £800,000, there has been raised by mortgage £362,128; and there have been redeemed out of the sinking funds mortgages to the amount of £12,570. During the past financial year, the capital expenditure amounted to £174,111, of which £132,284 was upon the Granton works; £18,771 was a proportion of the cost of carburetted water-gas plant; £14,544 was upon mains and service-pipes; £5187 upon gas-meters; and £3324 upon gas cooking and heating stoves. The coal carbonized amounted to 154,011 tons, and cost £84,466. The quantity of oil used was 2639 tons; and it cost £7496. Purifying materials, oil, water, and sundries cost £9241; salaries and wages, £41,395; and repairs and maintenance of works and plant, £13,469. The total cost of manufacture of gas was £156,067. Distribution came to £25,168, of which £11,416 was for salaries and wages, £7599 for repairs and maintenance of pipes and attendance at gasholders, and £6153 for repair and maintenance of meters. Management cost £8933; feu duties, rates, and taxes, £11,999; pensions and allowances, £798; law and parliamentary expenses, £67; accidental damages, £15 12s.; alterations at offices, £144; and discounts, abatements, and bad debts, £5316. The total expenditure was £208,509; the total revenue, £266,754. There was derived from the sale of 1,645,318,500 cubic feet of gas £242,600; from the sale of coke, £5853; from tar and ammoniacal liquor, £17,576; and from waste lime, £33. The balance was made up of rents and transfer fees. The sinking funds amount to £82,255, of which £4810 is for repayment of borrowed money, and £77,445 for redemption of annuities. The reserve fund amounts to £3280. The total of the gas-stove account is £13,678. During the year stoves were purchased to the amount of £4471; and there was expended upon repairs and fitting up £2043, less £500 charged against the revenue account. There was received for the hire of stoves, £1726; for stoves sold, £668; and for fitting up, £295. The stoves on hand are valued at £10,989.

The accounts were presented at a meeting of the Commissioners held yesterday. In terms of the Act of Parliament, they must be audited, and lie on the table for a month before they can be adopted.

COVENTRY CORPORATION GAS SUPPLY.

Annual Report.

At the Meeting of the Coventry City Council last Tuesday, the annual report of the Gas Committee was submitted, as follows: "The total revenue for the year from all sources, including sales of gas, coke, tar, &c., amount to £67,722. The expenditure for coal and all other materials, wages, repair and maintenance of works, &c., amount to £52,972. This leaves a gross profit of £14,750, to which must be added the interest on the reserve fund, £132; making a total of £14,882. Against this are the following charges: Instalment to sinking fund £1767, income-tax £225, interest on capital employed £8413; making a total of £10,405. This being deducted from the gross profit leaves a net surplus profit of £4476, which is at the disposal of the Council. During the past year, gas certificates to the amount of £4179 have been paid off out of the sinking fund. The whole of the outstanding gas annuities fall to be redeemed on the 30th inst. by the payment of an amount equal to 24 years' purchase of the annuities. During the year the following amounts have been expended on capital account: New mains and service pipes £1853, new meters £734, balance of costs of promoting Act of 1898 £82—total, £2669. The total borrowing powers exercised since the acquisition of the gas undertaking amount to £219,438, of which £13,641 has been repaid out of the sinking fund, leaving capital liabilities amounting to £205,797. Against this the Corporation have reserve and sinking funds amounting to £21,405, making a balance of liability of £184,391. The Committee recommend that of the surplus profits for the year £4000 be paid over to the general district fund, and the balance of £476 carried forward to the next account."

Alderman Andrews said, in moving the last report he should have the honour of presenting on behalf of the Gas Committee, he would first call

attention to the state of the business during the year. Three years ago they had a sudden increase in the consumption of gas of 24 per cent.; and since then it had remained exactly stationary. They had an increase from 405 to 504 million cubic feet. In the following year, it was also 504 millions, and last year it stood at just the same figure. No capital had been spent on the works during the year; but capital to the extent of £1852 had been expended on new mains and service-pipes. There was a further outlay of £734 on prepayment meters, the use of which was rapidly extending in the city. The consumption of gas generally had been the same; but the quantity taken in the cycle trade had certainly been less—the decrease having been made up by an increase in house consumption. The total receipts for the year, including the sale of coke and other items, were £68,722. This was less than it used to be; for two years ago the turnover was nearly £72,000—the explanation being the introduction of water gas, which resulted in less coal being purchased and coke sold. The figures showed the usual fluctuations in different items. During the year they received nearly £700 more for coke, £135 more for breeze, £600 less for tar, and nearly £200 more for sulphate. The total expenditure was £52,972; leaving the profits at £14,749. After paying the interest and sinking fund, there remained a net surplus of £4476. New stables had been erected at a cost of £3000, and new scrubbers at a cost of about £3200, two-thirds of which had been charged to last year's revenue, and £1000 carried forward to next year. The Committee recommended that £4000 be handed over to the relief of the district rate; the remaining £476 to be carried forward. This brought him to the probability of the coming year's finance. They had to provide for a large increase in the price of coal, of something like 1s. 3d. a ton, which upon the full year's consumption would make a difference of £2350 to the undertaking; but the whole of this would not fall in the first year's account, as they had a large stock in hand. They, however, expected that the increased cost of coal would mean something like £1000. As a set-off against this they would have a reduction of the rate of interest on the loan for part of the year, which might probably amount to about the same; so that as far as the finances could be foreseen and adjusted, it appeared that the balance at the end of the next year would be about the same as the present.

Mr. Griffiths seconded the motion.

After a short discussion,

Alderman Andrews, replying to a question, said the Committee had probably about 7000 tons of coal in stock, and their present contracts would run on into next month; so they would only have the advanced price to pay for about half of the year. This they calculated would mean something like £1000. Another year, unless there was some change, they would suffer the whole of the increase, which was computed at about £2350.

The report was adopted.

BURTON-UPON-TRENT CORPORATION GAS SUPPLY.

A Satisfactory Year.

The Borough Accountant of Burton-upon-Trent (Mr. Barrow Fish) has lately presented to the Gas and Electric Light Committee of the Corporation the revenue account of the Gas Department for the year ended March 31. The sale of gas for ordinary purposes in that period produced £29,786, or £994 more than in the preceding year; the income from street lighting was £102 less; meter and stove rents were £104 more; coke produced £745 more and sulphate £591 more, while tar and spent lime brought £196 less, the sales of fittings £122 less, and sundries and interest £93 more. The total income was £44,371, against £42,263—an increase of £2108. The expenditure amounted to £38,265, against £36,733—an increase of £1532; more money having been spent for coals, stokers' wages, and renewal of retorts, but less on the general maintenance of the works, and the repair of mains, services, meters, and stoves.

Alderman Lowe, the Chairman of the Gas and Electric Light Committee, moved the adoption of the Committee's minutes at the last meeting of the Council. He characterized the results as eminently satisfactory, under all the conditions and circumstances of the year's working. There was a gross profit of £12,169—an increase of £554. After providing for interest on, and the annual instalment of, the loans, amounting to £5763, and setting aside £300 to the depreciation fund, the available surplus profit amounted to £6105, compared with £5529 in the previous year—an increase of £576, notwithstanding the fact that the price of gas was 2d. per 1000 cubic feet less for the whole period, as against only six months of the previous year. At the meeting when the reduction was proposed, he said they would still realize a profit of at least £5000, but the actual amount, as he had said, had been £6105. The consumption of gas exhibited steady and satisfactory progress. The amount derived from the sale of gas showed an increase of £892; the consumption of gas, one of 11,235,500 cubic feet; while the quantity taken through prepayment meters was 5,046,400 cubic feet. But even more satisfactory than this was the fact that these meters were making such satisfactory progress. During the year under review, the number of ordinary consumers was 4748—an increase of 101; while the number of penny-in-the-slot consumers was 829, and was still augmenting. The amount expended during the year on capital account for extension of works, mains, and meters, had been £3659, and, in addition, there had been spent £3244 on prepayment meters, stoves, and fittings; making a total of £6903, and bringing the outlay to date up to £159,595. The sum of £3500 was received during the year on account of the loan for prepayment meters and stoves. This account on the 31st of March last was overdrawn to the extent of £5184, in view of future borrowings. The total amount of loans outstanding was £54,314. The reserve fund account, which was often touched by other departments of the Corporation, amounted to £13,184, an increase of £2686. The depreciation fund amounted to £9600; but the reserve fund figures were perhaps the most interesting of all. The total amounts taken therefrom during the year were: In aid of the general district rate, £9000; electric light department (mains), £534; Messrs. Salt and Co., for water contamination, £121 18s. 7d.; and flood embankment expenses, £13 14s. 5d.—making a total of £9669 13s. paid out of the reserve fund, which was made up solely of the gas-works profits. In fact, he did not know what they would have done without it in many cases. It had saved about 9d. in the pound; and he hoped this amount would never be brought on to the rates. The gas-works had been described as the milch cow of the Corporation; and the department had, at any rate, earned for the ratepayers something approaching £250,000. He did not like to speak of the future as he did of the past; but he might tell the Council that the estimate for coal was 30,000 tons, at an average cost of 1s. 6d. per ton more than last year, which meant an increase in cost of something like £2250. But although this looked a rather serious item, he was glad to say there was a prospect of a silver lining in another direction; for when coal went up, the cost of residuals also advanced, and he hoped that next year the profits on the year's working would not be less than £6000. Alderman Turner said he had great pleasure in seconding the proposition; and it enhanced his pleasure when he recollected that he had the privilege of seconding the proposal to reduce the price of gas. At that time there were many dismal forebodings as to the result; but he was glad to say that their expectations had been more than realized, and had thus fully justified the action of the Committee. Mr. Lathbury said he had some figures which were rather interesting, and he pointed to the fact that they had earned this year on share capital only 7·3 per cent. dividend. He contended that if they had kept to the old price, instead of making a reduction of 2d. per 1000 cubic feet, they would have made £2222 more than they had done. The figures given by Alderman Lowe hardly justified the assertion that the profit realized was larger than before. In the year 1897 they made £6727. He should like to know if the comparisons were made with the year when there were six months in which there was a reduction, or in the year when the full price was charged all through. They made this year 7·3 per cent. profit on the share capital; but in 1897 they had 11 per cent.; the year before that 12 per cent.; and the year before that 13 per cent. In 1898 they only made 8·4 per cent.; whereas now they were making 7·3 per cent. Consequently, the rates had suffered to the extent of £2222. Alderman Lowe, in reply, said the profits this year were equal to 7·6 per cent. It was hardly fair that for every increase in the rates the gas consumer should be penalized. The gas-works were the property of the town, and customers should receive some consideration. In dealing with the figures, he urged that it was absurd to compare the concern with a public company, as the two were not on all-fours. When they considered that the gas-works had realized nearly a quarter-of-a-million of money for the benefit of the town, he thought it was manifestly unfair that they should be always taxed when expenses were on. Let the rates stand on their merits, and then they would perhaps display a little more economy than they did at present. So far as he personally was concerned, he was perfectly satisfied with the balance-sheet, even though there had been a reduction in the price of gas of 2d. per 1000 cubic feet. The minutes were passed.

On the same occasion, the Gas and Electric Light Engineer (Mr. F. L. Ramsden) reported that the quantity of gas consumed in the five weeks ending the 2nd of June was 20,902,000 cubic feet, being an increase of 666,000 cubic feet, compared with the corresponding period last year.

COWES DISTRICT COUNCIL GAS DEPARTMENT.

The Past Year's Working.

The statement of accounts of the Gas Department of the Cowes District Council for the year ending March 31, as prepared by the Secretary to the Special Gas Committee (Mr. W. Halliday) shows that the revenue from the sale of gas was £4699; the rental of meters and fittings produced £256; and the sale of residuals, £867—the total income being £6033. The expenditure on the manufacture of gas was £2889; on distribution, £164; and on management, £219—the total being £3543. The balance carried to the profit and loss account is consequently £2490. The accounts have been examined by Messrs. Alfred Lass, Wood, and Co., who certify that the capital raised during the year amounted to £6824; making a total indebtedness of £62,386. The capital expenditure amounted to £951; making the total £59,612, and leaving a balance unexpended of £2774. The profit on the revenue account (£2490) added to the unappropriated profit from the previous account (£591) makes £3081, out of which interest and instalments of loans have been paid to Dec. 31, 1898, and Feb. 28, 1899, respectively, amounting to £2319. The balance, subject to proportions of interest and instalments to the 31st of March, amounting to £921, is £762. The revenue therefore is still slightly in arrear of the actual charges. Notwithstanding the net loss—about £160—it is not intended to go to the rates for assistance; and the price of gas remains as in the Company's time—3s. 11d. The largest profit made by the Company was £1951, in 1897, when their sale of gas amounted to 19,501,000 cubic feet. The quantity of gas sold in the past financial year was 30,630,400 cubic feet; and 31,210,400 cubic feet are accounted for, out of a make of 34,716,000 cubic feet. The bulk of coal and cannel carbonized was 3555 tons. The estimated quantities of residuals were: Coke and breeze, 2298 tons; tar, 35,686 gallons; and ammoniacal liquor, 42,943 gallons.

GAS PROFITS OF THE CHORLEY CORPORATION.

At a recent Special Meeting of the Chorley Town Council, there was some discussion as to how the rates could be lowered; one of the proposals being to secure larger profits from the gas-works. Among the speakers was Mr. Stanton, who protested against the principle of making the gas consumers pay a higher price in order that the rates might be lowered. Alderman Howarth also argued that the principle was bad. He held that if there were any profits on the undertaking, the consumers ought to have the benefit. Alderman Whittle pointed out that if there were a loss the ratepayers had to find the money; and he argued that it was only fair, now there were profits, that they should reap the benefit, and that the profits should go to relieve the rates. Mr. Stanton said he did not see why the consumers in the past had been allowed to have gas at a lower rate than they should do. He thought the gas consumers ought to have gas at a reasonable price; and if any improvements were required, the Corporation should borrow—repayment probably extending over thirty years. Mr. Cook was of opinion that profits from the gas-works should go in reduction of the meter-rents and the charge for

automatic meter supplies. He considered that, as the ratepayers had sustained a loss, they ought to participate in the profits. It was resolved that the rates should remain at the same figure as last year—viz., 3s. 10d. in the pound. The estimated profit from the gas-works last year in aid of rates was £997; but only £750 was realized; and, according to the Gas Committee, it is not at all likely to be very much more in the current year.

GAS v. ELECTRIC LIGHTING AT ADELAIDE.

"Nothing but ill-fortune seems to attend the South Australian Electric Light and Motive Power Company in its efforts to light the streets of Port Adelaide with electricity." This was the dolorous phraseology with which the South Australian "Register" of the 5th ult. prefaced the announcement that on the previous evening the whole of the thoroughfares of Port Adelaide were left in total darkness, through the failure of the electric light. According to that paper, the fault lay not with the machines but with the outside mains; and a thorough search at the junction boxes failed to reveal the source of the trouble. The Company's Consulting Engineer (Mr. W. W. Crawford) stated that he could not account for the mishap unless the three mains of the system had come into absolute contact, either by accident or design, at some point. Speaking to a representative of another paper—the "Advertiser"—on the subject, Mr. Crawford stated that in the whole course of his experience he had never seen such an accident. It was entirely inexplicable. The lights started well, and suddenly went out with a flash. The fault, however caused, absorbed all the current of the machines; and nothing short of the whole of the three mains being directly connected could account for it. An ordinary leak, he said, would certainly not cause the loss of all the current; and, in fact, it was almost impossible for the occurrence to be caused by an accident. The electric lighting of the streets in Port Adelaide commenced on the 1st of February; and the result may be judged by what has since transpired in the Town Council. It could not have been particularly successful, for two of the members asked the Mayor if he did not think it would be necessary to call the Lighting Committee together at once to consider the "very unsatisfactory state of the street lighting." The Mayor replied that, as they were "not paying anything for it," they might forbear a little. Like certain other great bodies, electric lighting appears to move slowly at Port Adelaide. In August, 1895, the Corporation accepted a tender for lighting the streets by electricity; but it was not till February of the present year—3½ years later—that the streets were lit. Before the lighting commenced, the Mayor of Port Adelaide ventured to say that a better contract had not been made by any other Corporation in the world. He remarked that St. Vincent Street ought, within twelve months, to be "the best-lit street in Australia." The extent to which this prediction has been fulfilled may be gathered from the Town Council proceedings before mentioned, and from the extracts from newspapers already quoted. The Gas Company's contract with the Adelaide Corporation is for not less than 927 incandescent burners in the street-lamps of the city of Adelaide, for five years from Sept. 1, 1897; and consequently the contract still has more than three years to run. The Electric Lighting Company have agreed to supply in Adelaide thirty 2000 "nominal" candle power electric arc lamps for five years from Sept. 1, 1899, at a price (also "nominal") of 1s. per lamp per annum. Consequently, it is not difficult to calculate the loss the Electric Company will sustain on this contract. These thirty arc lamps are to be lit from sunset to sunrise every night throughout the year; and the Company have to pay to the Corporation 10s. for every lamp not lit and kept alight each night.

THE GAS, ELECTRIC LIGHT, AND WATER UNDERTAKINGS OF THE OLDHAM CORPORATION.

Oldham has lately been celebrating the Jubilee of its incorporation; and, as a natural consequence, considerable prominence has been given in the local papers to the development of the municipal institutions in the fifty years which have elapsed since the town was raised to the higher position. We take from the "Oldham Chronicle" the following particulars as to the gas, electric light, and water undertakings:—

The gas was acquired in 1853, since which date it has been vastly developed. At that time the Company's central works were at Greaves Street, with branch works at Royton, Shaw, Leesbrook, and Hollinwood. The works at Shaw and Leesbrook have been dropped; but those at Greaves Street and Hollinwood have been greatly extended. A new branch at Higginshaw was established in 1870. The producing capacity of the Company's works was approximately 100,000 cubic feet daily, and the number of consumers was about 2000. The price of gas varied from 4s. to 5s. 2d. per 1000 cubic feet, according to the amount consumed, less a discount of 8d. Consumers outside and inside the borough were charged the same price. As compared with the output of 1853, the present operations show a vast increase. The actual production last year was no less than 1181 million cubic feet. The weight of coal and cannel carbonized being 115,880 tons. The business is a source of profit to the Corporation, who are able to devote about £9000 a year towards the relief of the rates out of the money received from the Gas Committee. In addition to this pecuniary advantage to the public, the municipal buildings and the street lamps are supplied with gas free of cost. The quantity of gas thus consumed free is 66,540,000 cubic feet.

The introduction of the electric light led to the formation in 1890 of the Electric Lighting Committee, who commenced operations in a small way at the Rhodes Bank works; and the business done is not yet very large. The amount of energy generated last year was 589,633 units, of which 454,907 units were sold. The area of supply does not embrace the whole town, but is being gradually extended; 3161 yards of cables having been added last year. Even this small business has returned a net profit of £884, which has been accomplished after a reduction of the price to consumers. With the advent of the electric car, and the proposed municipalization of the tramways, the operations of the Committee are expected to assume larger proportions. The adaptation of the existing tramways to electric traction, and the laying down of lines along the principal highways of the town, will bring electricity into every part of the borough. The Corporation are seeking powers to extend their works so as to cope with the great demand which will be made upon them; and it is quite anticipated that in a few years electricity will be available in every ward, and possibly in every street.

The incorporation of the borough had not long taken place when the new Corporation began to look ahead in the important matter of the local water supply, which was in the hands of the Oldham Gas and Water Company. The Company owned two reservoirs at Strinesdale, which were supplied with water from a drainage area of 660 acres. These reservoirs had been constructed under powers acquired in 1825 and 1838 respectively. How far they served to supply the town with water cannot be ascertained; but the plenitude of pumps and the multiplicity of wells then in use indicate that not all the people had received pipe water into their houses. The Corporation opened negotiations with the Company with a view to taking over the Strinesdale reservoirs and the waterworks plant. The Company were not difficult to deal with; and the Corporation made a good bargain. On Oct. 2, 1850, the corporate seal was affixed to an agreement; and the Company transferred all their rights to the Corporation, in consideration of a perpetual payment of 10 per cent. on each £10 share. These terms applied to both the gas and water undertakings, which were handed over at the same time as going concerns. This, however, was only a beginning. Doubts were entertained as to whether the Strinesdale reservoirs could long be used in conjunction with their natural gathering-grounds. There were many farms and dwellings in the neighbourhood; and the water was thus likely to be rendered unfit for drinking purposes. This possibility, together with the increasing necessities of a growing population, caused the Corporation to seek parliamentary powers to construct additional works and reservoirs at Piethorn and Brushes Clough. The Piethorn scheme embraces five completed reservoirs, having a united storage capacity of 696 million gallons, receiving water from a drainage area of 1820 acres. The Brushes Clough reservoir draws from a gathering-ground of 700 acres; but, on account of land cultivation, water is only collected from one-half this area. The first sod of another reservoir at Denshaw was cut on July 26, 1876; and seven years later the supply of water therefrom was turned into the mains. The drainage area measures 1350 acres; and the storage capacity of the reservoir is 381 million gallons. The entire cost, including the purchase of the land, was £253,002. The construction of the Castleshaw works was commenced in May, 1887, and completed in September, 1891. The water is conveyed to Strinesdale through 4½ miles of 30-inch cast-iron pipes. The drainage area is 950 acres; and the aggregate storage capacity is 389 million gallons. The cost of these works inclusive of land, was £225,584. Another addition was commenced in July, 1894, at Rooden, which was included in the powers obtained in 1886. This unfinished reservoir will, when completed, afford storage for 240 million gallons. It has but a limited gathering-ground of 25 acres; but it is intended to convey into it the rainfall from 778 acres of moorland. This will complete all the schemes for which statutory powers have been obtained. The total available drainage area is 4323 acres; and the aggregate storage capacity is 1706 million gallons. The total amount expended up to March 25, 1898, on works, land, mains and meters was £1,136,556. There are some 46,000 houses now supplied with water, which means that probably 200,000 persons are in the enjoyment of this daily requisite at the hands of the Corporation.

ELECTRIC LIGHTING NOTES.

The Chelmsford Town Council have adopted a report of the Electric-Lighting Committee, recommending that an offer of £24,000 be made to the Electric Light Company for the purchase of their undertaking as a going concern.

The Yarmouth Town Council have assented to a proposal of the Electric Lighting Committee to make application to the Local Government Board for a loan of £27,000 for electric light extensions; but no portion is to be spent until full details have been furnished to the Council, and full discussion permitted on the subject.

The Middlesbrough Corporation Electric Light Committee had before them last Tuesday a communication from the Local Government Board sanctioning the borrowing of £36,000 for electric lighting purposes. The North-Eastern Railway Company have written to inquire the terms upon which the Corporation will supply power to drive twenty electric cranes; but the Town Clerk says the works will not be ready for at least twelve months.

In the face of the advice of Mr. Hawtayne that the value of the Oswestry Electric Lighting Works was only £8220, the Committee appointed by the Corporation to negotiate for the purchase have agreed to pay the Company £11,250 for them, which is £500 less than the Company originally asked. The agreement was confirmed by the Council last Tuesday by eight votes to five; and it was also decided to apply for permission to borrow £18,000 for the purpose, and to carry on the undertaking. The objecting councillors promise to continue their opposition at the inquiry which will be held into the application.

Recently there has been a mild agitation at Chesterfield regarding the supply of electricity to the public. This movement had its origin in the proposals set forth in the prospectus of the Electricity Distribution Company, whose Bill was thrown out by a Parliamentary Committee. More recently a private engineering company located in the town made a definite offer to provide the borough with electricity at a certain price. But a large section of the Corporation took the view that what could be done by a private firm could be accomplished by the Municipality. Some time ago a Special Committee of the Council were appointed to consider the matter in all its bearings; and this Committee have recommended that a well-known firm of electricians be instructed to supply plant to the Corporation at a cost of about £13,000. The proposal came up for consideration by the Council last Tuesday, and was confirmed.

The Bridgwater Corporation have an Electric Lighting Order which a short time ago the Town Council decided to carry out. It does not seem, however, that the members of that body are of one mind as to the advisability of introducing electric lighting into the borough; and, accordingly, Mr. D. Bradfield gave notice that he would move the rescission of the resolution already passed. At the meeting of the Council on the 15th inst.,

he brought forward his motion; and though an attempt was made to obstruct him on a point of order, the objection was overruled. Mr. Bradfield urged that on the occasion when the resolution was passed there was not a full Council, and, moreover, that the report put before them was rather a one-sided affair. He cited the cases of Bolton and Liverpool in support of incandescent gas as against electric lighting, and said he thought, as Bridgwater had its hands pretty full of other things, it would be unwise to go in for an electric light undertaking, which seemed to him to be very uncertain. He added that Taunton had been repeatedly mentioned as a town which was doing well with the electric light; but he found that in several shops where it had been introduced it had been removed, and replaced by incandescent gas-burners, on the ground that the former light was not to be relied upon, and also on that of expense. The cost of public lighting at Taunton was now £1200 a year more than when the electric light was introduced. It had been said that the town had extended; but supposing the extension had been such as to make a difference of £200 a year in the cost of lighting, there had been an increased cost of £1000 a year as compared with the time before the electric light was started. Mr. T. W. Manchip seconded the motion. He urged that the Council were not justified in incurring an expenditure of £17,000, or it might be £30,000, in the present position of affairs. He advised waiting—perhaps a month would do—to see the result of what was going on now. Mr. Waddon combated the statement made by Mr. Bradfield as to Taunton. He said he had had a letter from the Chairman of the Lighting Committee of the Town Council, which showed that, instead of people giving up the electric light and putting in incandescent gas burners, last year they doubled what they had done before, and made a profit of £700, which represented a saving to the ratepayers of something like 2½d. in the pound. He said the Lighting Committee had no interest in advocating the electric light. The Council asked them to do a certain thing, and they did it conscientiously, and had put their report before them. Mr. Aldridge asked what was paid to the Gas Company for lighting the town. Mr. Waddon replied about £1011 up to the time the Committee made their report; and at present about £1030. Mr. Aldridge thought that they ought to progress with the times, and that Bridgwater should have the electric light in the streets. If they took into consideration what they paid for gas, they would be only about £300 out of pocket, and would have the electric-light plant under their own control. Mr. Whitby cited statistics to the effect that out of 56 provincial towns, 33 made a profit and 23 a loss; among the latter being 20 who were in their first, second, or third year. He thought these figures were encouraging. After some further discussion, Mr. Bradfield's motion was lost by nine votes to eight.

The Cromer Urban District Council have just decided upon introducing the electric light. At the last meeting of that body, the Clerk (Mr. P. E. Hansell) reported, in reference to a meeting of the Highways Committee held on the 19th ult., that, as the Electric Lighting Order had been granted by the Board of Trade, and the Confirmation Bill was well on its way through Parliament, the Committee had considered the steps to be taken to establish electric lighting works within the Council's district. As a preliminary step, they directed him to obtain information from other towns in which electric lighting works are owned by the local authorities; and the replies had been considered, and a tabular statement and summary thereof prepared. The Committee further caused a circular to be sent to all the householders in Cromer, asking whether the Council might rely on their custom in the event of works being started. The replies received comprised about 1000 lamps in 32 houses. The Committee had also made inquiries as to a suitable site for a station, and had been informed that one could be obtained. The Committee had also had interviews with Mr. Cozens-Hardy, the Council's Electrical Engineer, and had received a supplementary report from him. Under the Order as made, it would be open to the Council, either to establish works themselves, or to transfer their powers to a company. After full consideration of the subject and the Engineer's reports, the Committee had resolved to recommend the Council to establish electric lighting works for the district, and to proceed with the scheme forthwith. The recommendation gave rise to a long discussion, in which the Engineer was closely questioned as to the possibility of the scheme paying. He stated that £10,000 was his approximate estimate of the total cost of the undertaking; and he considered that the whole expenditure would he covered by £11,000, including law charges and everything. Mr. Jarvis asked if he thought the Council would put in twelve arc lamps, 50 yards apart, to cost £14 per annum each, when at the present time the place was lighted for about £33 a year, as against the proposed outlay of £168. Then it was suggested to place four arc lamps round the churchyard, at a cost of £64 per annum. At the present time there were eight lamps, and their total cost worked out at £2 7s. per lamp, or £18 16s., as against £64. The Engineer remarked that there was no comparison between the lighting. Mr. Jarvis expressed the opinion that an ordinary Welsbach Company's burner would produce an amount of light for 3d. which would cost 6d. to obtain by electricity; and that the Company's new oil burner would give the same light for 1½d. He should like to see the electric light in Cromer if the undertaking could be worked at a profit; but if the Council were going to carry it on at a loss, he said it would not be fair to call upon the occupiers of 700 houses to make up at the end of the year the deficiency which had been caused by the action taken by the Counsel in response to the petition of the occupiers of 32. The Engineer observed that they would reap the profits in the years following—a remark which was received with laughter. Mr. Jarvis said he did not believe that would be for some years, and repeated that he did not think the Council would consent to pay £168 per annum for what now cost but £33. The Engineer said, of course, light for light, electricity did not pretend to be as cheap as gas, if both were burnt for the same time. Eventually, Mr. Jarvis moved that the question be postponed for six months. Mr. Davison seconded the proposition. The Chairman (Mr. G. Riches, jun.) said he agreed with adopting the electric light under certain conditions; but he did not believe in rushing the thing through until the Council saw how the other public undertakings they had on hand worked out. The Engineer said he was perfectly willing to let half his fees stand over until the thing paid, if they proceeded forthwith, because he was convinced that it would be successful. A division was then taken, when Mr. Jarvis's proposition was defeated by eight votes to five, and the recommendation of the Committee was adopted.

THE INSPECTION OF GAS LIQUOR AND OTHER WORKS UNDER THE ALKALI ACTS.

The Sub-Inspectors' Reports.

In the "JOURNAL" for the 6th inst., we noticed the report of the Chief Inspector under the Alkali, &c., Works Regulation Acts (Mr. R. Forbes Carpenter) for the past year. We now give some extracts from the reports of the Sub-Inspectors.

Reporting from Ireland, Mr. E. G. Ballard says there is nothing to call for special remark in connection with works for the production of sulphate of ammonia. They are all well conducted, and supplied with arrangements for dealing with the sulphuretted hydrogen evolved. Taking all the places where sulphate is manufactured in Ireland, the number of works absorbing the sulphuretted hydrogen in oxide of iron is 21; those burning it, 5; those working on the continuous system of distillation, 13; and those on the intermittent system, 13. There has been no change in these figures since 1897. The proportion of sulphuretted hydrogen treated by oxide purification is 96·5 per cent.; by combustion, 3 per cent. During the past year 2653 tons of sulphate were made. At works where tar is distilled, proper arrangements are in use for dealing with the noxious vapours; and the works are all in good order. There is another class of works where tar and pitch are heated for the manufacture of felt for roofing purposes. Here much has been done of late years towards dealing with the pungent vapours arising from the operations.

The Sub-Inspector for the North of England district (Mr. J. W. Young) reports that there were registered last year 47 sulphate of ammonia works, only one of which produced liquor ammonia. The quantity of sulphate made was 10,592 tons. In the majority of instances, the foul gases evolved are absorbed in oxide of iron purifiers. The proportions are as follows: Oxide purifiers, 72·8 per cent.; Claus sulphur recovery, 8·7 per cent.; other satisfactory methods, 5·4 per cent.; combustion and delivery to chimney, 13·1. Of the six works in the fourth group, one has erected a new plant comprising continuous still and purifier; two have purifiers building; and a fourth has a Claus sulphur-recovery plant erected. Of the two remaining works, one will either cease to register or erect improved plant; the sixth is a very small works in a ruinous condition throughout. At two of the works of the third group, the foul gases pass to the burners of vitriol plants; at the third, a specially-designed furnace is used for their destruction, after thorough condensation of the "devil" liquor. The products of combustion are led through coolers up a limestone tower flushed with water, and thence to the retort-house chimney. Tests are taken daily at the works; and Mr. Young's own tests have shown a condensation of sulphur dioxide exceeding 96 per cent. of that entering the tower. This process has not been long in use, and some difficulty has been found in securing the adequate supply of air necessary to prevent deposition of sulphur. A scientific refinement of the designer of the plant, to render the furnace self-intensive by drawing in the air at the top of the burner through channels the walls of which were heated by the diffused heat of combustion, had to be abandoned. Under certain conditions, a struggle took place between the air to pass downwards and the fumes of combustion upwards, in which the air was not always victorious. The air supply is now obtained through larger holes below; and, in consequence, the temperature of the furnace is lowered. But tests have failed to detect sulphuretted hydrogen escaping. A further difficulty has resulted from the selective attack of the sulphur dioxide on the limestone of the tower. The harder portion of the stone remaining ceases to neutralize the acid. Accordingly, a higher escape of acid gases was found on testing the exit from the tower, unless the stone was frequently repacked, and the unattacked harder lumps removed. This was a source of stoppage and expense for labour. The difficulty will be met by the substitution of a softer and more homogeneous stone.

In all but 12 works, or 25 per cent. of the whole, continuous stills are employed for the disengagement of the ammonia. Many improvements were carried out last year. New plants were erected; and purifiers superseded combustion of foul gases or their direct escape into the air. Hydraulic change-valves to purifiers were substituted for the unsafer existing valves at two works, and are to be adopted elsewhere. Much pressure was necessarily applied, as the ignorant carelessness shown in some places was deplorable. At two works, the foul gases were habitually discharged directly into the air—in one instance within the building, where the men were engaged; at another, to save water used for the cooling of the condenser, the gases passed away to the purifier almost at boiling temperature. Mr. Young says this tendency to insufficient condensation is one of the commonest errors of the smaller works. Room still remains for improvement in various directions. At two works the present position of the purifiers constitutes a death-trap for workmen entering to clean them, unless the utmost precautions are taken. Three plants for working the sulphur-recovery process in connection with sulphate manufacture were in operation throughout the year; and a fourth was started in the autumn. In every instance the gases leaving the depositing-chamber traverse a limestone tower and oxide purifier.

Mr. Ballard, who, in addition to Ireland, takes the district comprising Cheshire, North Wales, and part of Lancashire, has no change to report with respect to sulphate of ammonia works; and there have been no further alterations in plant. The number of works using either the intermittent or the continuous system of distillation remains the same; so that there are, as in the previous report (allowing for one continuous process works which has not been registered this year), 17 working on the continuous system, 5 on the intermittent system, 17 absorb the sulphuretted hydrogen in oxide of iron, 4 burn it either under the boiler fires or in the retort flues, and 1 converts it into sulphur in a Claus kiln. The following are the proportions of sulphuretted hydrogen treated by various methods in terms of sulphate made and per cent. of total make: Claus process, 9·7; oxide purification, 69·2; by combustion, 14·1. Mr. Ballard explains that, in regard to 80 per cent. of this 14·1 per cent., the liquor contains but little sulphuretted hydrogen in combination; the sulphur, if present, being in other forms. The total amount of sulphate of ammonia made in the district during the year was 3533 tons.

Mr. Herbert Porter, who has under his supervision North and East

Lancashire and part of Yorkshire, says there are now in his district 14 liquor ammonia and 41 sulphate or muriate of ammonia works; the total quantity of liquor distilled being equivalent to 14,212 tons of sulphate manufactured. The proportion distilled to liquor ammonia was 3·71 per cent. The sulphuretted hydrogen evolved during the process of sulphate manufacture is dealt with by absorption by lime or oxide of iron (mostly the latter) to the extent of 61·31 per cent. of the liquor distilled. The escape of the gases from between the sides of the purifier and the oxide continues to receive attention; and two works during last year fitted flanges inside the purifier to baffle the gases, so that they must pass into the oxide. At another the large gas-main fixed outside the building for cooling the gases did not reduce their temperature sufficiently—causing the oxide in the purifier to become too hot; and after a shower of rain, bad or weak places were found in the oxide, whereby the gases escaped. It was pointed out to the Manager that cooling by water was necessary; and suitable pipes were fixed to supply water, which flows over the outer surface of the pipe and greatly reduces the temperature. In addition to the hot gases as above mentioned, air is pumped into the gases in this condenser, which also contributed to the high temperature in the purifier by the active chemical action set up. These are now the only works in the district in which air is employed while the purifier is in use. Most works now connect the purifiers, when not in operation, to the chimney draught, by which air is drawn down through the oxide, assisting in its resuscitation, and ventilating the purifier when it is necessary to remove the oxide.

Mr. Porter emphasizes the fact that too much care cannot be taken when cleaning out plant and drains connected with this class of manufacture. As an illustration of this, at one works, while cleaning out the catch-pit into which the spent lime liquor and "devil" water are run before passing into the sewer, a man was gassed after having removed nearly all the deposited sludge. Mr. Porter happened to visit the works just after the man had been removed from the pit. A doctor was sent for at once, as the man was almost in a state of collapse, and, while waiting, hot water was given to him, causing him to vomit; and, as he was becoming cold, small doses of rum were administered alternately with hot water. In a short time he was able to walk about with assistance, or sit up in a chair. The doctor arrived and administered a further dose of rum, as the temperature was falling, and gave instructions to continue the exercise, although the man kept imploring to be allowed to lie down and sleep. After four hours' watching and exercise, he was sent home, was fairly well the next day, and the day after that he resumed his work. While mention is made of the steps taken in this particular instance of emergency, Mr. Porter says it is only with the view of urging the need of proper medical aid being summoned at once in all such cases.

There are 29 tar-works registered in this district; being one less than before. There were no accidents or explosions during the year; greater attention being paid to the minor fittings in this class of plant, such as safety-valves and water-seals, both of which play a very important part in the safe working of a tar-still.

Messrs. Richmond and Co., Limited, have recently held exhibitions of gas appliances at Edinburgh, Risca, and Newton Stewart, with lectures by Misses Richmond and Barker.

THE LONDON COUNTY COUNCIL AND THE WATER QUESTION.

Preparing for Next Session.

The following report of the Water Committee of the London Council is upon the *agenda* for the meeting to-day:—

The Council having, on our recommendation, suspended the Standing Orders so far as they affect proposals for legislation in the session of 1900 dealing with the Metropolitan Water Supply, it has become necessary for us, in the absence of a report from the Royal Commission, to consider as to the steps which it will be necessary to take in order to place the Council in a position to deposit in Parliament next session, should it so decide, Bills dealing with the question of the water supply for London. This question is of such magnitude, and involves such a very large amount of work in connection with the promotion of legislation, that we are anxious that the Council's officers shall be afforded sufficient time in which to make preparations. We have consulted the Engineer and Valuer, upon whom will devolve the work of preparing plans, books of reference, and estimates; and they ask to be authorized to begin with as little delay as possible, in order to avoid the risk of incompleteness and inaccuracies likely to result from the work being done under undue pressure. We concur in the view taken by these officers; and we think that the Council should authorize the necessary expenditure, which, judging from the estimates we have received, will probably amount to about £3000 during the period from now to the date when the Council will decide whether or not it will deposit Water Bills in the next session of Parliament. The amount provided in our annual estimate will probably not be sufficient to meet the whole of this expenditure, and it may be necessary to submit a supplemental estimate when the annual estimates are being revised. We recommend—"That, with a view to placing the Council in a position to proceed with Bills dealing with the London Water Supply in the next session, should it so decide, the Water Committee be authorized to incur an expenditure of £3000 in making all necessary preparations."

Winding Up of the Cobham Gas Company.—Last Tuesday, the shareholders of the Cobham Gas Company passed a resolution voluntarily winding up the Company. In December last, it was agreed to sell the works to a new Company, who propose to greatly extend the undertaking. The old shareholders will be paid out in full; and the surplus, it is expected, will be equal to from 20 to 30 per cent. upon their holdings.

Entertainment to the South African Lighting Association's Workmen.—The annual concert and entertainment arranged by the Manager of the South African Lighting Association (Mr. W. Arnott) in honour of the Queen's Birthday, took place at the Mutual Hall, Port Elizabeth, on the 23rd ult. There was a crowded assemblage of the employees and their friends—some 350 in all, including about fifty of the Kaffir lamplighters and stokers. An attractive musical programme was gone through, which was thoroughly enjoyed. The hall was lighted by clusters of Denayrouze burners of 1000-candle power, a brilliant effect being produced.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1738.

Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.	£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 13	10½	Alliance & Dublin 10 p. c.	21½—22½	..	4 13 4	150,000	5	May 31	8	Oriental, Ltd. . . .	7⅞—8	..	5 0 0
100,000	10	,,	7½	Do. 7 p. c.	15½—16½	..	4 10 11	135,000	5	,,	8	Do. New, £4 10s. pd.	6½—7	..	5 14 3
800,000	100	Jan. 3	5	Australian 5 p. c. Deb. .	104—106	..	4 14 4	15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1⅜	..	4 11 5
200,000	5	May 12	6	Bombay, Ltd. . . .	6½—7	..	4 5 9	60,000	5	Mar. 29	7	Ottoman, Ltd. . . .	5½—5⅝	+⅛	6 1 9
40,000	5	,,	6	Do. New, £4 paid .	4⅞—4⅞	..	5 1 1	500,000	100	June 1	6	People's Gas 2nd Mtg. of Chicago Bonds .	102—106	..	5 13 2
380,000	Stk.	Feb. 24	12	Brentford Consolidated	275—280	..	4 5 9	851,070	10	Apl. 27	7	River Plate Ord. . . .	11—11½	—¼	6 1 9
240,000	,,	,,	9	Do. New . . .	215—220	..	4 1 10	250,000	Stk.	Dec. 30	4	Do. 4 p. c. Deb. .	103—105	..	3 16 2
50,000	,,	,,	5	Do. 5 p. c. Pref. .	140—145	..	3 9 0	250,000	10	Mar. 29	10	San Paulo, Ltd. . . .	16½—17½	..	5 14 3
159,375	,,	June 15	4	Do. 4 p. c. Deb. . .	126—130*	..	3 1 7	135,000	Stk.	Mar. 29	10	Sheffield A.	237—240	..	4 3 4
220,000	Stk.	Mar. 29	11½	Brighton & Hove Orig. .	265—270	..	4 5 2	209,053	,,	,,	10	Do. B.	237—240	..	4 3 4
226,320	,,	,,	8½	Do. A. Ord. Stk. .	194—197	..	4 6 4	447,427	,,	,,	10	Do. C.	237—240	..	4 3 4
973,500	Stk.	Feb. 24	5	Bristol, 5 p. c. max. .	126—130	..	3 16 11	5,600,000	Stk.	Feb. 10	5⅝	South Metrop., 4 p. c. Ord.	135—140	..	3 16 2
420,000	20	Mar. 29	10	British	46—48	—1	4 3 4	1,460,000	,,	Jan. 13	3	Do. 3 p. c. Deb. . .	101—103	..	2 18 3
50,000	10	Feb. 24	12	Bromley, Ord. 10 p. c. .	25—27	..	4 5 11	—	—	—	—	Tottenham and A. .	—	—	—
75,000	10	,,	9	Do. 7 p. c. . . .	20—22	..	4 1 10	—	—	—	—	Edmonton B. .	—	—	—
500,000	10	Apl. 27	6	Buenos Ayres (New) Ltd.	10—10½	..	5 14 3	—	—	—	—				
220,000	Stk.	Dec. 30	4	Do. 4 p. c. Deb. .	103—105	..	3 16 2	182,380	10	June 15	5	Tuscan, Ltd.	9—10*	..	5 0 0
150,000	20	Mar. 10	8½	Cagliari, Ltd. . . .	28—29	..	5 13 10	149,900	10	Jan. 3	5	Do. 5 p. c. Deb. Red.	99—101	..	4 19 0
100,000	10	June 1	7½	Cape Town & Dis., Ltd.	13—14	..	5 7 2								
50,000	50	May 2	6	Do. 6 p. c. 1st Mort.	56—58	..	5 3 5								
550,000	Stk.	Apl. 13	13½	Commercial Old Stock .	312—317	..	4 5 2					WATER COMPANIES.			
200,750	,,	,,	10½	Do. New do. .	245—250	..	4 4 0	746,184	Stk.	Dec. 30	11	Chelsea, Ord.	318—323	..	3 8 1
200,750	,,	June 15	4½	Do. 4½ p. c. Deb. .	143—148*	..	3 0 10	150,000	,,	,,	5	Do. 5 p. c. Pref. .	168—173	..	2 17 10
800,000	Stk.	June 15	10	Continental Union, Ltd.	190—195*	..	5 2 7	160,000	,,	,,	4½	Do. 4½ p. c. Pref. '75	150—155	..	2 18 1
200,000	,,	,,	7	Do. 7 p. c. Pref. .	182—187*	..	3 14 10	175,785	,,	Mar. 29	4½	Do. 4½ p. c. Deb. .	155—160	..	2 16 3
51,600	Stk	Feb. 24	14	Croydon A 10 p. c. . .	—	—	—	1,720,560	Stk.	Apl. 13	7	East London, Ord. . .	220—224	..	3 2 6
168,400	,,	,,	11	Do. B 7 p. c. . . .	—	—	—	654,740	,,	Dec. 30	4½	Do. 4½ p. c. Deb. .	157—160	..	2 16 3
555,000	Stk.	Feb. 24	5½	Crystal Palace Ord. 5 p. c.	135—140	+2	3 15 0	390,000	,,	,,	3	Do. 3 p. c. Deb. .	102—104	..	2 17 8
60,000	,,	,,	5	Do. 5 p. c. Pref. .	140—145	..	3 9 0	700,000	50	June 15	7½	Grand Junction 10 p. c. max. .	171—114*	..	3 5 9
486,090	10	Jan. 27	11	European, Ltd. . . .	23—24	..	4 11 8	310,000	Stk.	Mar. 29	4	Do. 4 p. c. Deb. .	135—140	..	2 17 2
854,060	10	,,	11	Do. £7 10s. paid .	17—18	..	4 11 9	708,000	Stk.	Feb. 10	14	Kent	360—365	..	3 16 9
14,993,075	Stk.	Feb. 10	4⅞	Gas-light and Coke 4 p. c. Ord. . .	109—111	—1	4 8 3	160,000	,,	,,	7	Do. New, 7 p. c. max. .	210—215	..	3 5 1
2,600,000	,,	,,	3½	3½ p. c. max. . .	100—102	..	3 8 8	1,043,800	100	Dec. 30	10½	Lambeth, 10 p. c. max. .	303—308	..	3 8 2
3,799,785	,,	,,	4	4 p. c. Con. Pref.	127—129	..	3 2 0	406,200	100	,,	8	Do. 7½ p. c. max. .	230—235	..	3 8 1
3,843,975	,,	June	3	Con. Deb.	99—101*	..	2 19 5	350,000	Stk.	Mar. 29	4	Do. 4 p. c. Deb. .	135—140	..	2 17 2
70,000	10	May 31	8	Hongkong & China, Ltd.	13½—14½	..	5 10 4	500,000	100	Feb. 11	13⅔	New River, New Shares	430—435	..	3 3 3
3,800,000	Stk.	May 12	10	Imperial Continental .	223—228	..	4 7 9	1,000,000	Stk.	Jan. 27	4	Do. 4 p. c. Deb. .	137—142	..	2 16 8
473,600	Stk.	Feb. 10	8½	Do. 8½ p. c. Deb. Red.	102—105	..	3 6 8	902,300	Stk.	June 15	7½	South-wark and Ord. . . .	204—209*	—2	3 11 9
75,000	5	June 15	6	Malta & Medn., Ltd. .	5—5⅛*	+⅛	5 9 1	126,500	100	,,	7½	7½ p. c. max. .	193—198*	..	3 15 9
560,000	100	Apl. 4	5	Met. of 5 p. c. Deb.	112—114	..	4 7 9	489,200	Stk.	,,	5	5 p. c. Pref.	165—170*	..	2 18 10
250,000	100	,,	4½	Melbourne 4½ p. c. Deb.	110—112	..	4 0 4	1,019,585	,,	Apl. 13	4	Vauxhall 4 p. c. A Deb.	135—140	..	2 17 2
541,920	20	May 31	5	Monte Video, Ltd. . .	13—14	..	7 2 11	1,155,066	Stk.	June 15	10	West Middlesex . . .	300—305*	+3	3 5 7
617,946	Stk.	Feb. 24	9½	Newc'tle & Gatesh'd Con.	228—233	..	3 19 5	200,000	,,	,,	4½	Do. 4½ p. c. Deb. .	154—158*	..	2 17 0
264,855	Stk.	Dec. 30	3½	Do. 3½ p. c. Deb. .	107—110	..	3 3 8	200,000	,,	Mar. 10	3	Do. 3 p. c. Deb. .	102—104	..	2 17 8
					* Ex div.										

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Offices, Commercial Road, Pimlico, last Thursday, under the presidency of Mr. F. S. Clayton.

The Secretary (Mr. G. H. Gill) read the notice calling the meeting, and the report of the Company's Auditors.

The Governor, in moving the adoption of the report, stated that the gross income for the half year ended March 31 last amounted to £83,864, or £1816 more than in the corresponding period of 1898; while the working expenses were £26,956, or £67 less. This was a satisfactory state of affairs; and it justified the Directors in recommending a dividend for the half year of 11 per cent. per annum—being at the same rate as that declared at the previous half-yearly meeting. It also justified the Board in what they at that meeting declared as their opinion—namely, that the increase of dividend would be maintained. During the half year, 303 new supplies had been laid on, which were estimated to produce an additional annual water-rental of £1243, averaging about £4 2s. 4d. per house; while, on the other hand, 156 houses had been pulled down for improvements, entailing a temporary loss of income of £274. The latter were small houses; and the average water-rental received therefrom was only £1 15s. per annum. There was little doubt that these houses would be replaced by much larger ones, from which at least £4 per house might be expected. During the half year, 1515 yards of service-mains had been laid to meet extensions in the district—principally in Fulham, where building operations were still going forward at a rapid rate. At their last meeting the fact was mentioned that the system of constant supply was completed throughout the Company's district. The waste inspectors, who had been previously busy in examining the fittings of the last sub-district which was to be placed under constant supply, had since then been at liberty; and they were now going through the whole of the district for the purpose of placing it under Deacon's waste-water meters. At the present time 50 per cent. of the Company's supplies were under this system; and when the whole of the distict was included, the Board believed that the result would be that the prescribed daily quantity of 35 gallons a head would be materially reduced. The works in progress consisted of the new service reservoir at Putney, which Messrs. Aird and Sons were under contract to complete by next March. The Directors had little doubt that this work would be finished about that date. This very important work would double the area of the Company's storage of filtered water at Putney Heath; and therefore when the new reservoir was finished there would be a storage capacity there of 22 million gallons. The other work now in course of execution was the raising of the banks of the subsidence reservoirs at West Molesey, which Messrs. Docwra and Son were under contract to complete by November next. He feared, however, that this work would not be finished until next year. These two new works, as might be imagined, involved a considerable expenditure—in fact, nearly £80,000. Fortunately, the Company had the necessary funds available for the purpose of meeting the outlay, because since the last general meeting the Directors had issued 34,215 ordinary £1 shares at £2 premium, which had since been converted into ordinary stock. A small portion of this capital was, in fact, raised at a premium of £2 2s. per share. This was a very satisfactory state of things, and showed that, so far as finances went, the Company were in very comfortable circumstances. It was, of course, impossible to say what might be the future of the Metropolitan Water Companies. Until the Royal Commission had issued their report, a forecast on this subject could not be made. But, whatever might be the tenour of the report, the proprietors might be quite sure that if the Companies were allowed to go on as hitherto, the Directors would do their best to perform their duties, not only to the proprietors, but also to the public. On the other hand, if the purport of the report of the Royal Commission was for the purchase of the undertakings by any public body, the proprietors—in this Company, at all events—might rely on the Board doing their utmost to obtain the best possible terms.

The Deputy-Governor (Mr. Jackson Hunt) seconded the motion.

Mr. Besley, Q.C., remarked that the confidence which the proprietors had in the management of the Company was shown by the ready way in which they had paid a premium of £2 for every £1 share of the last issue. The Company had thus received, say, £100,000 of capital, of which only £33,000 would bear interest.

Mr. Brewster inquired whether there was any renewal and depreciation fund.

The Governor replied that the Company had a contingency fund. Moreover, the Directors did not divide the whole of the profits. All repairs, too, were made good out of revenue.

The motion was then put, and carried unanimously.

Resolutions were also passed approving the payment of the dividends recommended, and re-electing the retiring Directors and Auditor.

A vote of thanks to the Governor and Directors brought the meeting to a close.

The Price of Gas at Haverhill.—The question of reducing the price of gas at Haverhill was discussed at last week's meeting of the District Council. It was moved by Mr. F. D. Unwin that the price should be 3s. 9d. per 1000 cubic feet, allowing 10 per cent. for manufacturing purposes, and 2½ per cent. discount for cash. He thought this would encourage small consumers. They had now £666 outstanding, which, if a discount had been allowed, would have been in the bank. The resolution did not include a 10 per cent. allowance on cooking and heating stoves. Mr. Jarvis favoured a 10 per cent. allowance for cooking and heating, and objected to the 10 per cent. discount on gas used in warehouses or shops of manufacturers. Mr. Beasley did not consider the 2½ per cent. would be a means of getting the accounts paid quicker. Mr. French said they might compliment their Manager (Mr. Gibson) on being able to so manage the works that this year the expenses had been about £160 less, and he had made £298 more profit than the previous year. This would certainly justify the Council in reducing the price. The motion was carried; but the 10 per cent. allowance for cooking and heating was referred back to the Committee.

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MARCH, 1899.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

I send you the annual financial statement issued by Mr. John S. Gibb, the Treasurer to the Edinburgh and Leith Gas Commission, and a summary of the accounts, prepared by myself. The statement in itself indicates that a prosperous year has been concluded. The net profit is £2969, which compares with £2595 for the year ending in May, 1898. The Commissioners have been gradua'ly, and of set purpose, eating off the large surpluses which they made in 1894 and 1895, and which they have been applying year by year to various purposes, carrying forward the balance. A year ago, with the help of this fund, they had a net surplus of £27,000. Now it is down to £21,000, and will, if the Commissioners adopt the suggestion of the Treasurer, be still further reduced this year. It is a valuable fund to have at this time, when capital charges are growing rapidly, in connection with the new works at Granton. The liability in respect of them is already £132,283—mostly the cost of the site (£124,000) which has been paid for. In the course of the year the mortgage debt of the Commissioners rose from £220,398 to £362,128—an increase of £141,730—and the interest charge upon it increased from £6768 to £10,002. This is outlay which in the meantime is almost wholly unprofitable, and will be so until the new works are open. The Commissioners have to face several lean years before they enter upon what is being looked forward to as the time of plenty.

When the accounts for the past twelve months are compared with those for previous years, it is seen what a satisfactory rate of advance is being maintained. The total revenue is increased by £19,708; and of this, £14,539 is due to the increased sale of gas, £239 to increased sales of coke, £4609 to increased sales and better prices for tar and ammonical liquor, and £318 to increased rents from properties not in the Commissioners' own occupation—that is, practically, Granton House, which is let to Mr. Reginald Macleod, the Queen's Remembrancer for Scotland. On the expenditure side, there is an increase of 1229 tons of coal carbonized at an additional cost of £1975; and an increase of 1266 tons of oil for carburetting purposes, at an additional cost of £3232. Purifying materials, &c., cost £2246 more, salaries and wages £1526, and repairs and maintenance £1683. The total charge for the manufacture of gas was £8664 more than in the year preceding, distribution cost £1511 more, and management £673 more. Feu-duties and casualties cost £3821 more, which cannot be altogether accounted for by the feu-duties payable to the Duke of Buccleuch in respect of the Granton properties, but must be attributed to a casualty falling due—one of those troublesome things which have to be met in Scotland at certain times, such as when a property comes into new hands, the feu-duty being then doubled. Rates and taxes are also up by £2279, due to higher rates, and the assessments upon the new properties. Pensions and allowances are down £215, and accidental damages £155. This latter item is very instructive. It only amounts to £15 12s. for the year. I find that during the past seven years the Commissioners have paid £430 10s. in damages for accidents. This works out at an average of £61 10s. a year. The exact wages bill is not given; but assuming that workmen receive £40,000 a year in wages, and the Commissioners were to insure their workmen at the low rate of 10s. per £100, their annual premium would amount to £200. In their case, therefore, judging from the experience of the past, insurance would not be a gain. After all, the best insurance against accidents is careful management. Discounts, abatements, and bad debts are increased by £779. The total expenditure is up by £16,457; and the gross surplus is also up by £3230.

But it is in the sale of gas that the advancing nature of the undertaking is best seen. The total was 1,645,318,500 cubic feet. As compared with the previous year the increase is 88,062,200 cubic feet. There was an increase reported in May, 1898, of 40 million cubic feet; in 1897 of 92 millions; in 1896 of 49 millions; in 1895 of 105 millions; in 1894 of 38 millions; and in 1893 of 10 millions. This represents an increase of 422 million cubic feet of gas in seven years. Since May, 1890, when the first complete year of the Commissioners' existence ended, the increased sale of gas has been 494 million cubic feet. More significant still is the fact that in the year ending in May, 1893, the revenue from gas was £245,036; while last year it was £242,600, or £2436 less than it was seven years ago. This is accounted for by the fact that in 1892-93 gas was selling at 4s. 6d. per 1000 cubic feet; while it is now being sold at 3s. Taking the price at 3s.—because there would not have been an increase of 422 million cubic feet if it had remained at 4s. 6d.—it is found that the consumers are being saved, at the present time, £65,736 a year. This figure is arrived at by taking the 422 million cubic feet at 3s., and adding the £2436 which the revenue was less last year than it was in 1893. It practically comes to this—that consumers are receiving a gift of £65,000 worth of gas a year. This is a record which can be pointed to with pride. An increase of 26 per cent. in seven years is an experience which has seldom been matched.

The Glasgow Corporation Gas Committee have this week purchased 591,000 tons of coal for the forthcoming year. The average price is slightly over 10s. 9d. per ton, and is about 1s. 6d. above that for the current year. Splint has been very largely purchased. Ell and cannel are also in the list. The greater part of the coal has been secured in Lanarkshire; but there are purchases to a considerable extent from the Ayrshire and the East of Scotland fields. The rise in the price of coal is explained by the circumstance that since last year miners' wages have been raised from 5s. 6d. to 6s. 3d. per day.

The Town Council of Dundee on Wednesday considered the accounts of the Gas Commission for the past year. Treasurer Ritchie, who submitted them, gave an explanation of the figures for the past year and the estimates for the current one, and proposed that the price of gas should be raised by 2d., making it 3s. 4d. per 1000 cubic feet to ordinary consumers, and 3s. 9½d. to users of prepayment meters. He said he confessed that, with the large surplus at their credit, and in view of the conviction he cherished that cheap gas was one of the most valuable gifts they could bestow upon the community, he would (notwithstanding the large increase in the price of coal) have refrained from asking the Council to raise the charge this year, had it not been for the reconstruction scheme. They were face to face with very considerable structural

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changes and some improvements in their existing system. The expenditure on these could hardly be placed at less than £60,000. A large part of the sum was to be devoted to the renewal of plant, and consequently could in no sense be described as capital expenditure. The expenditure on the new gasholder, and on some other appliances, might justly be included under the head of capital expenditure. He was not careful, however, to determine how much precisely in this connection should be charged against revenue, and how much against capital, because he had come to the conclusion that the entire cost of the scheme should be paid within the next ten years, and should therefore practically constitute a charge against revenue, and not against capital. It seemed to him that their capital fund was not adequately represented by the assets. Had those formerly in the management of the Gas Department been wise, they would have written down the capital fund by many thousands of pounds; and he was convinced that their financial position would never be stable and secure until they had done so. The chief reason why the price of gas in the city was higher than that in some other cities and towns in much the same circumstances as themselves, was the great disproportion between the sum that they required to devote to the repayment of capital and to interest, compared with their other expenditure. A much greater disproportion existed between their capital and revenue than existed in other cities and towns. The capital in Glasgow stood at £1,275,529, and the revenue at £631,644—the percentage of revenue to capital being 49·5; the price of gas was 2s. 2d.; the candle power was 21; and no discount was allowed. In Edinburgh, the capital was £593.507; the revenue, £247,047—the percentage of revenue to capital being 41·6; the price of gas was 3s.; the candle power was 25·4; and accounts above £50 were allowed a discount of from 2½ to 10 per cent., according to amount, no discount being allowed on accounts under £50. The capital in Dundee stood at £411,763, and the revenue at £82,790—the percentage of revenue to capital being 20·1; the price of gas was 3s. 2d.; the candle power was 24·3; and discount was allowed at 5 per cent. In Aberdeen, the capital was £278,581, the revenue £83,203—the percentage of revenue to capital 29·8; the price of gas was 3s. 1d.; the candle power was 23·5; and a discount of 1d. to 6d. per 1000 cubic feet was allowed, according to consumption. In Greenock, the capital was £156,469, revenue £41,354—the percentage of revenue to capital 26·4; the price of gas was 2s. 11d.; the candle power was 25·8; and no discount was allowed. The capital in Paisley stood at £134,032, and the revenue at £42,176—the percentage of revenue to capital being 31·4; the price of of gas was 2s. 6d.; the candle power was 27·2; and no discount was allowed. These figures amply confirmed his statement that the undoubtedly large price they paid for gas in the city was owing to the unduly great sums paid for the acquisition of the works, and to the amount charged to capital in general. The price could not properly be reduced until a reduction was effected in the capital; in other words, until the nominal value was brought into a closer relation to the real value of their works. It was this consideration that led him to propose that the total cost of the scheme sanctioned should be defrayed within the next ten years, at the rate, broadly speaking, of £6000 a year. If this were done, a most effective instrument for lowering the price of gas would come into their hands, and the reduction in price would be made with security. The only question with the Council would be whether the proposal he was making was not too sweeping, and whether the expenditure should not be spread over more than ten years. There were those, however, outside the Council, who seemed to be of opinion that the changes which were now imminent could have been long ago foreseen, and should have been provided for. He confessed to a certain sympathy with these views; and, in fact, he had acted on them ever since the management of the gas passed into the Town Council's hands. The contingent fund had been built up with this and similar ends in view; but he had always felt that he could not reasonably ask the Council to set aside large sums for this fund, until they had some definite scheme before them, involving a given expenditure. Such a scheme had now been adopted. Nominally, the sum of only £4000 was set down as the first payment towards the cost; and it would at once occur to the Council that this fell short of the £6000 per annum spoken of as the sum that would need to be provided. But the £4000 was in reality between £11,000 and £12,000. The contingent fund already amounted to £6540. To this there fell to be added, as provided in the estimate, £1000—making £7540. This amount, together with the £4000, made a total of £11,540, provided in anticipation of the charges involved in the scheme of reconstruction and extension. To prevent misconception, he might say he did not anticipate that it would be necessary to raise £6000 additional during each of the next nine years. It was too soon to speak confidently of the saving which would be effected by the new plant. This saving, according to the estimate of Mr. Foulis, would be at the rate of about £4500 per annum. If it were only £3000, the amount they would require to raise was reduced by this sum. He was not without hope that, with coal at its normal price, with trade prosperous, and with the new economies in operation, it might be possible for them to defray the entire cost of the new scheme within the next ten years, not only without any increase in the price of gas, but even with the price lower than the rate he now asked the Council to fix. After discussion, the accounts were adopted.

The annual report of the Hawick Gas Company states that the past year has been a prosperous one; the profits showing a surplus, after providing for payment of the usual dividend. The Directors recommend that the price of gas be retained at 3s. 4d. per 1000 cubic feet. The Muirkirk Gas Company have paid a dividend for the past year at the rate of 6¼ per cent. The Pitlochry Gas Company have paid a dividend at the rate of 5 per cent., and have voted a bonus of £15 to their Manager. The Elie Gas Company have paid a dividend at the rate of 3 per cent. The Kinross and Milnathort Gas Company have, out of a surplus of £361, paid a dividend at the rate of 7½ per cent., and have applied the balance of £136 to depreciation of buildings and plant. The Comrie Gaslight Company have, in view of necessary repairs upon their works, resolved not to pay any dividend for the past year, but have reduced the price of gas from 6s. 8d. to 6s. 3d. per 1000 cubic feet.

Another illustration of the unsuitableness of the arc electric light for lighthouse purposes, was furnished last Sunday night, when the steamer *Croma*, from Leith for New York, ran ashore on the May Island, at the

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mouth of the Firth of Forth. There was a fog at the time; and the vessel was close upon the island before the crew were aware of the fact. No light was visible. The vessel backed off and returned to Leith in a sinking condition. When she arrived at the port, she was drawing 7 feet more than when she sailed, and could not enter the docks. She was accordingly run ashore outside. The owners have contracted to have her salved for £500; but after this the cost of repairs will have to be met, as well as claims for damage to cargo. When to all this is added the loss of freight, it will be seen how much responsibility rests upon those who maintain an electric light upon the May.

At a special meeting of the Water Committee of the Glasgow Corporation, on Wednesday, the accounts for the year ending May 31 last were submitted. The revenue for the year amounted to £216,744, of which £207,784 was from rates, £5000 from hydraulic power works, and £3959 from river supply works. Adding to this the credit balance for the previous year, of £39.772, the total income was £256,516. The expenditure amounted to £155,552, of which £3813 was for river supply works and £5468 for hydraulic power works, while the balance of £146,270 included annuities and interest. Of the balance of £100,964 of revenue over expenditure, £58,427 has been carried to sinking fund account, and £42,536 to the credit of revenue account for the current year. The net increase of revenue during the last financial year was £5372 over that for 1897-8; the principal increases being £1491 for the domestic water-rate within the municipality, £1661 outside the municipality, £3773 for meter supplies within the municipality, £1329 for meter supplies outside the municipality, and £1530 for hydraulic power works. The largest decrease was £4880 on trade charges within the municipality. The amount expended on new works during the year was £63,929.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 24.

Sulphate of Ammonia.—There has been more inquiry, but the actual business done has been limited; and prices are again a shade easier. The closing quotations are £12 6s. 3d. to £12 8s. 9d. per ton f.o b. at the ports. The large makers are still engaged on contracts, and have very little to dispose of; and the indifference of buyers alone has prevented a recovery in values. Interest in the forward position has not taken any tangible shape; the range of prices being above buyers' ideas, and makers not seeing their way to making a substantial concession.

Nitrate of Soda is firmer on spot; and 8s. 3d. per cwt. is the quotation for fine quality.

LONDON, *June* 24.

Tar Products.—Benzols are in better inquiry; and a large business is reported for prompt and for the last half of the year at prices quoted below. Makers are asking more money for forward delivery. The outlook is a little more hopeful; but unfortunately large quantities of benzol from new coke-ovens both here and on the Continent are expected to come on the market next autumn. Carbolic acid continues in the even tenour of its way; the price not having varied more than 2d. for two years. A fair market still exists for creosote and tar oils, and the value of them looks like being maintained during the summer months. But for next winter's delivery, buyers are offering less money. Pitch is fairly firm; but buyers do not respond to the higher values makers are asking for next season. There is no change in anthracene, which is still nominally quoted at very low figures. Indeed for medium "B" quality, there is no market value at the moment.

Average prices are: Tar, 15s. 6d. to 24s. Pitch, east coast, 28s.; west coast, 25s. Benzol, 90's, 6¾d.; 50's, 7¾d. Toluol, 10d. Solvent naphtha, 11d. Heavy naphtha, 1s. Crude, 30 per cent. naphtha, 3¼d. Creosote, 3¼d. Heavy oils, 62s. 6d. Carbolic acid, 60's, 2s. 1½d.; 75's, 2s. 8d. Creosote salts, 47s. 6d. Anthracene, "A," 3½d. to 4d.; "B," 2½d. to 3d.

Sulphate of Ammonia is moderately steady. A little spurt took place in the earlier part of the week; and prices slightly improved, but buyers have shied off at the higher values now quoted. Stocks are reported to be exceptionally low; and makers, being well sold, are in very few instances quoting. To-day's value may be taken at £12 5s. to £12 7s. 6d., less 3½ per cent.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—There is nothing new of any special moment to report with regard to the coal trade of this district, except that the better qualities of round coal are now only in very slow request for house-fire purposes; while gas coal contracts have now practically all been settled, though extra quantities have been inquired for in various directions. As regards fuel for steam, forge, and engine purposes, the demand continues quite as brisk as ever, with a general shortness of supplies, except in some of the very lowest qualities of engine fuel. Prices are very firm at 12s. to 12s. 6d. for best Wigan Arley, 10s. 6d. to 11s. for Pemberton four-feet and seconds Arley, and 9s. 6d. to 10s. for common house coal. Collieries decline to contract forward with merchants, except subject to clauses in the contract providing for an advance in prices corresponding with any upward move in the market. Steam and forge coals show a hardening tendency, and average 9s. to 9s. 6d. per ton at the pit. The better qualities of engine fuel average 6s. 6d. to 6s. 9d. per ton for best, and 5s. 6d. to 6s. for medium sorts; while on forward contracts collieries are generally asking 1s. 8d. to 2s. 1d. over last year's rates. Some of the inferior sorts are, however, rather easier, at 4s. 9d. to 5s. 3d. per ton at the pit. Shipping is fairly active; but prices remain at about 9s. 6d. to 9s. 9d. per ton for ordinary steam coals delivered at the Garston Docks, 10s. at the High Level, Liverpool, and 10s. 6d. at the Manchester Ship Canal.

Northern Coal Trade.—After the local holidays, a good demand has been experienced for coal; and prices are on the whole firm. Best Northumbrian steam coals are from 12s. 3d. to 12s. 4½d. per ton f.o.b., second-class steam are 11s. 6d., and steam smalls about 5s. 6d. In the gas coal trade, there is a good demand for export, though that for local use is now at its ebb. The probability is that after stocktaking at the end of the month, there will be larger shipments. In the meantime,

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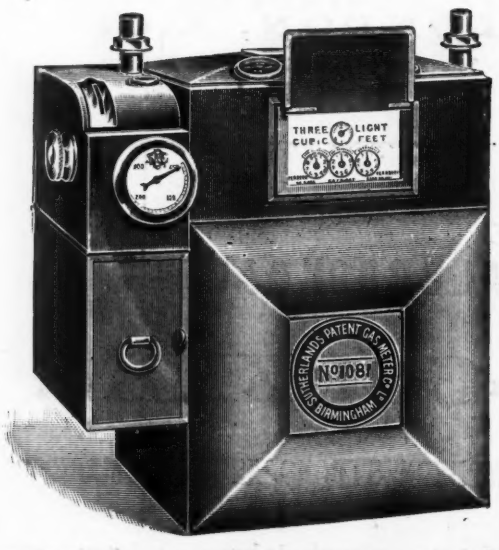

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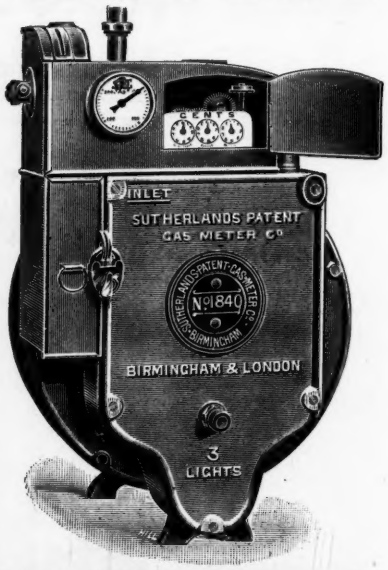

THE SUTHERLAND GAS-METER COMPANY,
ESSEX WORKS, BIRMINGHAM.

the prices are more generally quoted at 10s. per ton f.o.b. for best Durham gas coals; but any sales at these prices have hitherto been limited to small consignments. No additional contracts have been entered into of late. Gas coke is in good demand.

Scotch Coal Trade.—Trade is showing a tendency to get quieter, particularly in the shipping department. Home trade is active. All the great contracts for the year have been fixed, except that of one large Railway Company. The prices all round are higher by over 1s. a ton. The first steps towards the establishment of a Conciliation Board between masters and men have been taken; but nothing has as yet been decided except that the miners are to be consulted. The prices quoted are: Main 8s. 9d. to 9s. per ton f.o.b. Glasgow, ell 9s. 6d. to 10s. 3d., and splint 9s. 6d. to 9s. 9d. The shipments for the week amounted to 196,103 tons—an increase of 20,601 tons upon the previous week, but a decrease of 41,732 tons upon the corresponding week of last year. For the year to date, the total shipments have been 3,760,677—a decrease of 299,814 tons upon the same period of last year.

Blackpool Corporation Finances.—Mr. M. Heyes, the Borough Treasurer of Blackpool, has issued his annual summary of the Corporation accounts. Therefrom it is gathered that the Gas Department spent £41,635, and made a profit of £12,074; the electric light undertaking spent £8107, with a profit of £2126. Replacing the electric cables cost £13,239, and £2300 is being paid annually out of revenue as a suspense account to meet this expenditure. Up to March 31, the gas-works had cost £127,252; and the electric light works, £102,003.

Cleckheaton Gas Supply.—The minutes submitted by the Gas Committee at the meeting of the Cleckheaton District Council last Tuesday expressed approval of the Gas Manager's annual working statement. In moving the adoption of the minutes, Mr. Birkett, the Chairman of the Committee, mentioned that the amount of profit made during the year was £265 more than in the preceding year; but he could not promise any reduction in the price of gas, as the cost of coal would probably be higher during the ensuing twelve months. The statement showed the gross profit to have been £3510; equal, with the value of the gas allowed for public lighting, to 11·73 per cent. on the amount of capital employed.

Llanelly Water Supply.—At a meeting of the Water Committee of the Llanelly Council, last Thursday, it was reported that arrangements had been come to respecting a piece of land required for the proposed new reservoir. General and detailed plans were put in by the Surveyor, together with specifications, and it was stated that the work would cost between £40,000 and £45,000, of which about £13,000 would be for a bye-wash, which was strongly recommended some years ago by Dr. Parsons, of the Local Government Board, so that in the case of an epidemic it would not be necessary to cut off the whole of the supply. The new reservoir will have a capacity of just under 200 million gallons (that of the present one being 235 million gallons); and it will be situated at an altitude of about 100 yards above the highest parts of the town. The plans were approved.

The Price of Gas in South Africa.—The South African Lighting Association, with the view of encouraging as much as possible the use of gas, have decided to reduce the price, from the 1st prox., 10d. per 1000 cubic feet; making it 9s. 2d. for lighting, and 7s. 9½d. for cooking and power purposes. They claim that they will then be supplying the cheapest gas in South Africa by 1s. 4½d. per 1000 cubic feet, and this in spite of a heavy duty of 3s. per ton on coal—1s. extra duty having been added this year. The Association have now reduced their price 1s. 8d. per 1000 cubic feet in about eighteen months.

Hindley Gas and Water Supply.—At the last meeting of the Hindley District Council, the Chairman of the Gas and Water Committee (Mr. E. Grime) presented a report on the work in the year ending March 31. In the Gas Department, the quantity of coal and cannel carbonized was 5416 tons; the make of gas, 57,613,000 cubic feet; the make per ton, 10,637 cubic feet; the gas accounted for, 55,831,700 cubic feet, or 10,308 cubic feet per ton; the loss by leakage, 1,781,300 cubic feet, or 3·09 per cent. of the make. Comparing these figures with those for last year, there is a decrease of 42 tons of coal carbonized, and an increase of 2,849,600 cubic feet of gas made. The Committee received £400 more for gas, and £84 more for tar and ammoniacal liquor. After placing £1273 to the sinking fund, and paying £1267 interest on loans, there is a net profit of £132, which has been placed to the reserve account, which now amounts to £2292. The working of the Water Department has been satisfactory; the gross profit being £1240. After applying £330 in redemption of loans, and paying £600 interest, there is a net profit of £309; this being the highest ever realized by the department. This has been placed to the profit and loss account, which now amounts to £1339.

Gas-Stoves for School and Class Rooms.—Mr. E. A. Harman, the Engineer and Manager of the Huddersfield Corporation Gas-Works, is always on the alert to offer suggestions for extending the use of the commodity with the production of which he is identified; and in the current number of the "School Board Chronicle" he calls attention to the special suitability of gas heating-stoves for classrooms in connection with churches, chapels, or schools. He points out that in many instances the room is only required either before or at the close of the public services for the transaction of business matters in connection with various societies. Frequently, the verger or caretaker does not deem it necessary to light a fire, especially when it is contemplated that the meeting will be a short one. In many cases, however, what are expected to be short meetings develop into long ones; and if a gas-stove were available, it could be lit at any time, and would render immediate service by increasing the temperature of the room. Considering that the principal gas undertakings in the United Kingdom supply and fix gas heating-stoves free of charge for a few shillings rental per annum, the matter is not one for serious consideration, especially putting against the small expense the vastly increased comfort of those immediately concerned. As the summer is the best portion of the year for considering improvements in the warming and ventilation of schoolrooms, the Editor of the above-named publication gives currency to Mr. Harman's timely suggestion, which may possibly prove serviceable.

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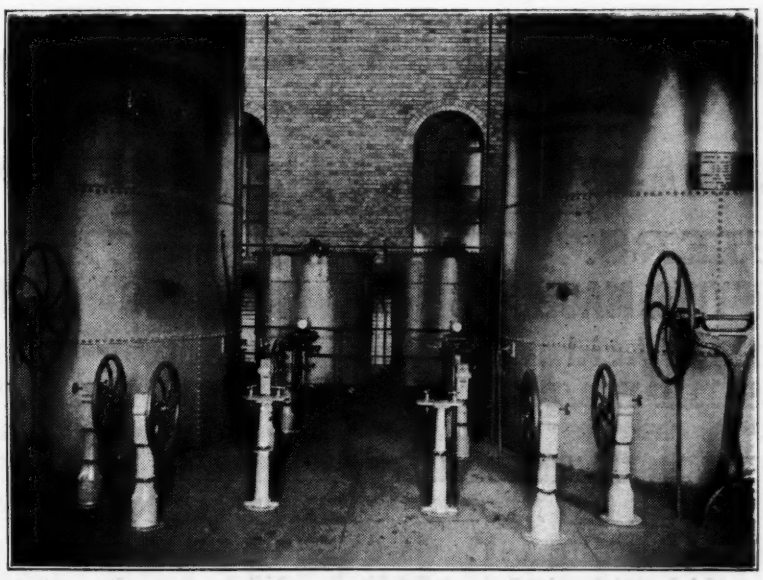

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Working Floor of Generator House. One Quarter Section of Birmingham Plant, Windsor Street Station.
The Maximum Daily Capacity of the Birmingham Corporation's Plant, which was erected by this Company, is 10 MILLION CUBIC FEET.

Increase in the Price of Gas at Darlington.—Owing to the advance in the price of coals, the Gas Committee of the Darlington Corporation have decided to increase the charge for gas by 3d. per 1000 cubic feet.

Kettering Water-Works Purchase.—At a special meeting of the Kettering District Council a few days since, a cheque for £127,880 was signed in payment of the purchase-money for the water-works, which, we believe, were to be taken over as from Saturday last.

Gas-Works Extensions at Carnarvon.—An inquiry was held last Thursday at Carnarvon by Colonel Slacke, on behalf of the Local Government Board, into an application by the Corporation for power to borrow £2000 for extending the gas-works. There was no opposition.

New Joint-Stock Companies.—The Witney Gas and Coke Company, Limited, has been registered with a capital of £5000, in £5 shares, to acquire the undertaking of the Witney Gas and Coke Company, and to carry on the business of a gas and other light and coke supply company in Witney, Oxfordshire, and elsewhere. The General Acetylene Syndicate, Limited, has been formed, with a capital of £10,000 in £1 shares, to adopt an agreement with G. Maruti, and to acquire and work certain patents which are not described.

Sales of Shares.—Messrs. Beaumont and Glover, of Wakefield, instructed by the Normanton Gas Company, recently sold £2000 of additional capital of the Company under the powers of the Normanton Gas Act, 1878. The stock was put up in 20 lots of £100 each, and was sold at an average price of £163 10s. 6d. per lot. The capital will rank for a standard dividend of 7 per cent. per annum, subject to the sliding-scale. At the Royal White Horse Hotel, Otley, last Friday, Messrs. Dacre and Son sold thirteen original £20 shares in the Otley Gas Company for £50 15s. each.

Water Supply for Leiston.—The Urban District Council of Leiston, in Suffolk, have applied to the Local Government Board for authority to borrow £1000 for carrying out a scheme of water supply. It is proposed to lay down mains, and purchase the water in bulk from Messrs. R. Garrett and Sons, Limited. The town is not within the area of any corporation or company, and the present supply is obtained from wells and stand-pipes. The new supply is to be drawn from a well 30 feet deep, and pumped into a covered tank capable of holding 8000 gallons. The firm are willing to charge only a nominal sum for the water.

Incandescent Gas v. Electric Lighting at Port Elizabeth.—On the occasion of a concert recently given in the Feather Market at Port Elizabeth, the hall was lighted by incandescent burners of the latest chimneyless type; the installation being fitted up by the South African Lighting Association, under the superintendence of their Manager (Mr. W. Arnott). The lighting was effected by clusters of two burners, with opal dome reflectors, each cluster giving a light of 420 candles with a consumption of 7 cubic feet of gas per burner per hour, or at the rate of 30 candles per foot. The total amount of light in the hall was equal to upwards of 5000 candles. Thanks to the enterprise of the Association, those who attended the function had an opportunity of comparing the effect of gas lighting under the best conditions with electric lighting.

The Parliamentary Expenses of the Rawtenstall Corporation.—Rochdale, Littleborough, and Todmorden have to pay a big bill for their fight on the water question twelve months ago; but their lot is not nearly so hard as that of the borough of Rawtenstall. The Rawtenstall Corporation spent £3000 in unsuccessfully opposing the Bury Water Bill last session; and they have incurred a further expenditure of £7000 in promoting a Bill of their own this session. The Bill having been rejected, they are unable to spread the repayment of costs over a number of years, and must raise it at once, which means a rate of 2s. in the pound.

Windsor Corporation Water Supply.—According to the report and balance-sheet drawn up by Messrs. Alfred Lass, Wood, and Co., the water undertaking of the Windsor Corporation is steadily and continually prospering; and within a few years' time—possibly two—the yearly receipts will be such that it will be no longer necessary to add to them from the borough funds in order to enable the debenture dividends to be paid. In 1892-3 no less than £1800 was advanced from the fund for this purpose, and the amount was increased in the following year to £1954. But in 1894-5 it dropped to £800; in 1895-6, it was £1000; the next year, £850; and in 1897-8, £660. This year it is much less.

The St. Helens Water Supply.—The members of the St. Helens Corporation Water Committee last Thursday made their annual inspection of the water-works. They drove to Eccleston Hill pumping-station, the Brownedge softening works, Whiston, Knowsley, and Kirby pumping-stations, and also inspected the works at Melling, where trial boreholes have been successfully made, and arrangements are being carried out for building a fifth pumping-station, by means of which it is expected that the town will have such a supply as will prevent any possibility of a water famine. The pumping capacity of the present stations, exclusive of Collins Green, is about 3½ million gallons per day; and when the works at Melling are completed, it is expected the pumping capacity will not be far short of 4 million gallons per day.

Brixham Water Supply.—The report on the water supply of Brixham, to which reference was made in last week's "JOURNAL," was, it appears, prepared jointly by Mr. Brereton and Mr. Codrington, of Westminster. It deals exhaustively with the difficulty in obtaining a supply in the high level. The Engineers point out that no water in appreciable quantity could be, or had been, found at a high altitude. At Redwell, where adits have been driven and shafts sunk to a considerable depth, the supply as gauged was only 2894 gallons, while the requirement is 125,000 gallons per day. Then the ground here is not watertight, and the construction of a reservoir would probably be most expensive. At Lupton, where trials have also been made, the results are not more satisfactory. Geologically, the main difficulty lies in the fact that the district is formed into a peninsula by the waters of Torbay on the one side and the River Dart on the other; bringing the land to a narrow neck, and cutting it off from any considerable watershed. The only solution of the difficulty is to collect water in the Woodhuish Valley, some 50 to 100 feet above sea-level, and pump it over the crest of the hill to a small high-level reservoir. The low-level portion of the district would continue to be supplied from the present source at Ladywell, the high-level from the new reservoir.

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The New Water-Works for Todmorden.—For their new water-works the Todmorden Corporation have secured about 170 acres of land at Howroyd and Gorpley, near Todmorden; being the greater portion of the site comprised in the Local Act obtained last year. The negotiations were completed yesterday week; the price agreed upon being £5900. The remaining portion of the site is not of great extent. It is situated on Inchfield Moor and Common, and will be acquired forthwith.

Paignton Water Supply.—A scheme for the improvement of the water supply of Paignton has been prepared by Mr. Vanstone, who formerly filled the position of Surveyor to the District Council. The present supply is obtained from springs in the vicinity of the town, but, owing to the growth of population, it is necessary to supplement this; and Mr. Vanstone proposes that Paignton, like many other towns in Devon, shall go to Dartmoor. The main idea of the scheme is to convey the water in a sufficiently large main to a hill overlooking Paignton, and to erect a distribution reservoir there. This would be at an altitude sufficient to afford a supply to the houses in the highest parts of Paignton. A number of members of the District Council recently visited the proposed source of supply, and were convinced that the water would be satisfactory both in quality and quantity. It is thought that it will not be necessary for the present to build a storage reservoir on Dartmoor. The estimated cost of the undertaking is £40,000.

Messrs. S. Cutler and Sons, of Millwall, have issued a revised catalogue of their carburetted water-gas plant, with reproductions of photographs of installations carried out by the firm, plans of plant, and other particulars of interest to those contemplating the introduction of this system of gas manufacture.

Messrs. G. Pettigrew and Co., of Middlesbrough, have received from the Kildwick Parish Gas Company, Limited, an order to erect complete their newest type of sulphate of ammonia plant.

The duplicate fitting and turning shops, equipped with heavy hydraulic machinery, and the adjoining new foundry, built at Smethwick by the New Conveyor Company, Limited, are now in full operation; and Mr. Gilbert Little, the Chairman and Managing-Director, is arranging to construct similar works in America, for the manufacture of automatic machinery for gas-works, collieries, and general mills and factories.

Messrs. R. Dempster and Sons, Limited, of Elland, have in hand new purifying plant for the Skipton Gas Company. It consists of six 20-feet boxes carried on staging formed of cast-iron pillars and steel joists, and covered in with an iron roof, together with oxide and lime hoists, &c. The work is being carried out in accordance with plans prepared by, and under the supervision of, the Company's Consulting Engineer, Mr. Robert Porter, of Elland.

By an announcement which appears elsewhere, it will be seen that the North Warwickshire Water Company are issuing at par 3000 ordinary shares of £10 each (ranking for dividend up to 10 per cent.); being part of the capital authorized by the North Warwickshire Water Act of last session. The Company's area of supply comprises eight parishes in the county of Warwick, has a rateable value of more than £50,000, and a population of 17,000, which is rapidly increasing. The works were opened on the 10th inst., as notified in the "JOURNAL" on the following Tuesday; and out of the applications received for domestic and trade supplies, a large proportion have already been accepted, and the connections made. The subscription list opened yesterday, and will close on or before Friday next.

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[For Illustrated Advertisement, see June 6, p. 1518.]

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TOWER SCRUBBER, Walker's, 5 ft. by 40 ft.
STATION METER, 8-inch, complete and perfect.
EXHAUSTER and ENGINE, combined, Waller's, 9-inch Valves, Governors, &c., complete.
GASHOLDER, 35 ft. by 14 ft. deep. Only six years old.
If sold this month will accept any reasonable offer.
J. FIRTH BLAKELEY & Co., Thornhill, DEWSBURY.

FOR SALE, cheap—
Two PURIFIERS, 8 ft. square by 4 ft. deep.
Two " 5 ft. " 4 ft. "
One " 5 ft. " 3 ft. "
One EXHAUSTER, 20,000 Cubic Feet per hour.
Two " 5000 " "
Also CONDENSERS, SCRUBBERS, WASHERS, GASHOLDERS and TANKS, VALVES, &c., &c.
Apply to SAML. WHILE AND SON, 60, Queen Victoria Street, LONDON, E.C.

THE Wolverhampton Gas Company have FOR SALE, at their Horsley Fields Works, the following SECOND-HAND PLANT comprising: Retort-Fittings, Two Exhausters, Two Steam-Engines, Two Boilers, Two Sets of Vertical Cast-Iron Condensers, Two Scrubbers about 25 ft. by 7 ft., Station Meter, Governor, Cast-Iron Tanks, Weighing-Machine, Roof Principals, &c.
The above can be seen by appointment.
For further Particulars apply to the MANAGER, Gas Company, WOLVERHAMPTON.

FOR SALE—One Station Meter, by J. & J. Braddock, complete with 6-inch Valves and Bye-Pass, quite equal to new.
One GOVERNOR, with 7-inch Inlet and Outlet Pipes, and Bye-Pass. Also by Braddock.
One Patent CENTRE-VALVE, with 6-inch Connections, by C. & W. Walker.
20 Cast-Iron RETORT MOUTHPIECES, oval, 21 in. by 15 in., fitted with Lids, Screws, and Cross-Bars.
A quantity of 6-inch and 8-inch VALVES.
Apply to H. I. WILLIAMS & Co., Kidsgrove, STAFFORDSHIRE.

FOR SALE.
THE Directors of the Staines and Egham Gas Company have FOR SALE a 10-inch HORIZONTAL CONDENSER, a LIVESEY WASHER, and a GOOD'S WASHER—the whole complete, with 10-inch Connections, Valves, &c. They are capable of dealing with 500,000 cubic feet of Gas in 24 hours. All in good condition, and can be removed at once. The whole to be taken down and carted from the Company's Works by the Purchaser.
Tenders for the whole as they stand to be sent to the undersigned.
THOMAS WEBB,
Manager.

SECOND-HAND Gas Plant for Sale—
One Holmes Patent SCRUBBER-WASHER, 5 ft. 6 in. diameter by 21 ft. long.
One BATTERY CONDENSER, 12 ft. by 12 ft. by 2 ft.
One HYDRAULIC MAIN, four lengths, each 11 ft. by 20 ft. by 18 in.
44 Ω-shaped RETORT MOUTHPIECES, 24 in. by 13½ in., Tangye's, Self-Acting Lids, Mal. Iron BENCH BINDERS, &c.
Address CLARKSON AND BECKITT, Maryhill Engine Works, Maryhill, GLASGOW.

FOR SALE—Two Purifiers, each 25 feet square by 5 ft. 6 in. deep inside, with Grid Bearers and Standards (no Grids).
Two 18-inch Centre Port BYE-PASS VALVES and CONNECTIONS.
Two WROUGHT COVERS in pieces, fitted with Cramps, Air-Valves, and Test-Taps.
GOLIATH TRAVELLER for Lifting Covers, with Travelling Wheels, Wrought-Iron Lattice Girders and Lifting Gear, and two lines of Steel Rails for same to run upon.
Have been in use only a short time, and recently removed from a Gas-Works.
Apply to NEWTON, CHAMBERS, AND Co., LIMITED, Thorncliffe Iron-Works, near SHEFFIELD.

GAS Plant for Sale. No reasonable offer refused:—
HYDRAULIC MAINS, MOUTHPIECES, &c. (Self Sealers). Also
Four Wrought Iron Annular Condensers.
Six-inch PIPE CONDENSERS.
TOWER SCRUBBER, 3 ft. by 12 ft., Tank Tippler, &c., complete.
TOWER SCRUBBER, 6 ft. 6 in. by 12 ft., complete.
TOWER SCRUBBER, 5 ft. by 25 ft., or 40 ft., complete.
ENGINES and EXHAUSTERS, 5000 to 30,000 feet per hour.
PURIFIERS, Several sizes and sets complete.
STATION METER, 8000 cubic feet per hour complete.
Six-inch STATION GOVERNOR, complete.
GASHOLDERS, one 35 ft. by 14 ft. counterbalanced. Six Years.
All guaranteed good order and condition.
J. FIRTH BLAKELEY & Co., Thornhill, DEWSBURY.

GAS COAL.
THE Directors of the Leyland and Farington Gas Company are prepared to receive TENDERS for their supply of COALS for the next Twelve Months. Quantity used, about 2200 Tons of Coal and 500 Tons of Cannel.
Tenders, endorsed "Gas Coal," to be in by Monday, the 24th of July.
No Special Forms issued.
CHARLES ELLIOTT.
Leyland, Lancs.,
June 21, 1899.

TAR AND AMMONIACAL LIQUOR.
THE Directors of the Leyland and Farington Gas Company are prepared to receive TENDERS for the surplus TAR and LIQUOR produced at their Works during the next Twelve Months (quantity made about 170 Tons of Tar and 500 Tons of Liquor), delivered free on rails in Contractor's Tanks.
Tenders, endorsed "Tar and Liquor," to be in by Monday, the 24th of July.
CHARLES ELLIOTT.
Leyland, Lancs.,
June 21, 1899.

URBAN DISTRICT COUNCIL OF HAVERHILL.
TENDERS FOR COAL.
THE Council invite Tenders for the supply of 1000 Tons of the best screened SILKSTONE GAS COAL, to be delivered free at Haverhill Station during the period of One Year from the 1st day of August next.
Delivery will be taken from time to time as the Manager shall require the same.
The Council reserve the right to divide the Contract into two of 500 Tons each.
The person whose Tender is accepted will be required to enter into the usual Contract for due performance thereof.
Tenders, in sealed envelopes, endorsed "Tender for Coal," should be addressed and sent to me, the undersigned, not later than the 10th of July next.
By order,
SIDNEY H. GRAHAM,
Clerk to the Council.
Haverhill, June 20, 1899.

TENDERS FOR TAR.

THE Directors of the Clayton, Allerton, and Thornton Gas Company are prepared to receive TENDERS for the purchase of the COAL TAR produced at these Works during a period of Twelve Months from the 1st day of July, 1899, to the 30th of June, 1900.

Quantity, about 400 Tons.

The Tar will have to be removed daily from the 1st of October to the end of April.

Sealed Tenders, endorsed "Tender for Tar," addressed to the Chairman at the Gas-Works, and to be delivered at or before Noon, on Monday, the 10th day of July, 1899.

The Directors do not pledge themselves to accept the highest or any Tender.

By order,
JOHN NIVEN,
Secretary and Manager.

Gas-Works, Clayton, near Bradford,
June 13, 1899.

TO SULPHURIC ACID MAKERS.

THE Directors of the Clayton, Allerton, and Thornton Gas Company are prepared to receive TENDERS for the supply from the 1st of July, 1899, to the 30th of June, 1900, or for a longer period, of 60 to 80 Tons per year (more or less) of SULPHURIC ACID for Sulphate of Ammonia Making. Made from Brimstone or Spent Oxide (not from Pyrites), and to Twaddel 146 to 148 at 60° Fahr.

The said Acid to be delivered into Storage Tank at the Company's Works.

Sealed Tenders, endorsed "Tender for Acid," to be addressed to the Chairman at the Gas-Works, and to be delivered at or before Noon, on Monday, the 10th day of July, 1899.

The Directors do not pledge themselves to accept the lowest or any Tender.

By order,
JOHN NIVEN,
Secretary and Manager.

Gas-Works, Clayton, near Bradford,
June 13, 1899.

URBAN DISTRICT COUNCIL OF SMETHWICK.

PAINTING GASHOLDERS, &c.

THE Gas Committee invite Tenders for painting GASHOLDERS and other IRON-WORK at the Gas-Works in accordance with the Specification which may be seen on application to Mr. B. W. Smith, at the Gas-Works, Rabone Lane.

The Contractor will be required to pay the Standard Rate of Wages recognized in the district.

Sealed Tenders, endorsed "Tender for Painting," addressed to the Chairman of the Gas Committee, to be delivered to the undersigned not later than the 11th of July next.

By order,
W. J. STURGES,
Secretary.

Gas Office: Town Hall, Smethwick,
June 22, 1899.

BOROUGH OF BEVERLEY.

TENDERS FOR COAL.

THE Gas Committee are desirous to receive TENDERS for the supply of COAL for a period of Twelve Months from the 1st of October next, to be delivered as from time to time directed by, and at the expense of, the Contractors f.o.b. at Keadby, or at the Pits, or at the Railway Station, Beverley, according to the terms of Contract. The Coal to be of the Best Kind, well Screened, free from Sulphur, Bats, Bind, Refuse, and Dirt, and to be weighed (21 cwt. to the Ton) upon the Corporation Machine. Payments will be made monthly so long as the Contract shall be duly fulfilled.

The Corporation do not bind themselves to accept the lowest or any Tender.

Further Information may be obtained of the Gas Manager, Mr. James Gibson, at the Gas-Works, Beverley; and Tenders, endorsed "Tenders for Coal," must be delivered at my Office not later than Wednesday, the 28th of June, 1899.

By order,
J. WILLIS MILLS,
Town Clerk.

Guildhall, Beverley,
June 13, 1899.

EDINBURGH AND LEITH CORPORATIONS' GAS COMMISSIONERS.

GASHOLDER AND FRAMING.

THE Commissioners are prepared to receive TENDERS from Structural Engineers, for the construction of a FOUR-LIFT TELESCOPIC GASHOLDER, 250 feet in diameter by 139 feet deep, together with External Guide-Framing, &c., &c., complete.

Specifications and Form of Tender, together with a set of copies of eleven Detailed Drawings, can be obtained on application to the Chief Engineer, Mr. W. R. Herring, Gas-Works, Edinburgh, upon the deposit of £10, which sum will be returned on receipt of a *bonâ-fide* Tender, and the return of the Drawings and Specification.

Tenders upon the Form provided, undetached from the Specification, are to be delivered to the undersigned on or before the 22nd day of July next, endorsed "Tender for Gasholder."

Drawings to be returned to the Engineer on or before the 30th day of July.

The Commissioners do not bind themselves to accept the lowest or any offer.

By order,
JAMES M'G. JACK,
Clerk.

25 Waterloo Place, Edinburgh,
June 9, 1899.

GAINSBOROUGH GAS COMPANY.

THE Directors of the above Company invite TENDERS for the supply of 7000 Tons of screened GAS NUTS, delivered at Great Central Railway Station, during the Year from July 1, 1899, to June 30, 1900.

Tenders, endorsed "Tender for Coal," to be sent to me not later than Tuesday, July 4.

The Directors do not bind themselves to accept the lowest or any Tender.

FRANCIS A. GAMBLE,
Secretary.

Gas Offices, Gainsborough,
June 21, 1899.

TENDERS FOR COAL.

THE Directors of the Holyhead and North Wales Gas and Water Corporation, Limited, are prepared to receive TENDERS for the supply and delivery of COALS to their various Works for the ensuing Year.

Full Particulars and Forms of Tender may be had on application to the undersigned, to whom sealed Tenders, endorsed "Tender for Coal," must be sent not later than Twelve noon, Thursday, July 6, 1899.

GEORGE E. SAVILLE,
Engineer and General Manager.

Conway Road, Penmaenmawr,
June 17, 1899.

CORPORATION OF EAST RETFORD GAS UNDERTAKING.

THE Gas Committee invite Tenders for the purchase of their surplus TAR and AMMONIACAL LIQUOR to be produced at their Works during the next Twelve Months ending June 30, 1900.

Sealed Tenders, endorsed "Tender for Residuals," to be sent in to the Chairman of the Gas Committee on or before July 1 next.

Further Particulars from the undersigned.

J. B. FENWICK,
Engineer and Manager.

Gas and Water Offices,
Retford, June 15, 1899.

SOUTH SHIELDS GAS COMPANY.

TO METER MANUFACTURERS.

THE Directors of the South Shields Gas Company invite TENDERS for the supply of DRY GAS-METERS required during the Year ending the 30th of June, 1900.

The Meters must be of the best quality, stamped, and delivered at the Gas-Works, carriage paid.

The Directors do not bind themselves to accept the lowest or any Tender.

Form of Contract and further Particulars may be had on application.

Sealed Tenders, marked "Tenders for Meters," to be delivered to the undersigned not later than Friday, the 30th of June next.

J. H. PENNEY,
Secretary.

Gas Offices: Chapter Row,
South Shields, June 16, 1899.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COALS.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 79,000 Tons of Best Well-Screened large GAS COALS, to be delivered between August, 1899, and the 30th of June, 1900, in monthly quantities in accordance with the Specification.

Parties tendering may do so for the whole quantity, or for quantities of from 5000 Tons upwards.

Forms of Tender and Specification of monthly deliveries may be obtained on application to the Engineer and Manager, Mr. H. Morley, M.Inst.C.E.

Sealed Tenders to be sent to the undersigned not later than Ten a.m. Thursday, the 6th day of July next, addressed to the Chairman of the Company, endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
May 31, 1899.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 25,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.

Sealed Tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than the 3rd day of July next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any Tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
June 1, 1899.

SETTLE GAS COMPANY.

TENDERS are invited for the supply, delivery, and erection of a DOUBLE-LIFT GASHOLDER.

Drawings and Specification may be seen at my Offices on the 6th of July.

Endorsed Tenders to be in possession of the Chairman of the Gas Company, Settle, not later than the Morning of the 10th of July.

JOHN WAUGH.

Sunbridge Chambers, Bradford,
June 22, 1899.

RADCLIFFE & PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for about 12,000 Tons of GAS COAL and CANNEL.

Particulars may be obtained from the undersigned to whom Tenders, properly endorsed, must be delivered on or before Friday, the 30th of June.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 12, 1899.

THE Directors of the Airedale Gas Company invite TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR to be produced at their Works during the Year ending June 30, 1900.

Estimated Quantity of Tar, 220 Tons, and Liquor 400 Tons.

The Directors do not bind themselves to accept the highest or any Tender.

Sealed and endorsed Tenders, for either One or Two Years, to be received on or before July 4, 1899, by the undersigned.

EDWIN THORNTON,
Secretary.

Gas Offices, Idle, near Bradford,
June 21, 1899.

BARNOLDSWICK URBAN DISTRICT COUNCIL.

(GAS DEPARTMENT.)

THE Council are prepared to receive TENDERS for the supply of 1700 Tons of best screened GAS COAL, to be delivered at Barnoldswick Station during the Year ending July 31, 1900.

The Council reserve the right of purchasing the whole or part of the quantity named.

Tenders to be sent in not later than Wednesday, July 5, 1899, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Gas Coal."

The Council do not bind themselves to accept the lowest or any Tender.

D. E. GARLICK,
Manager.

Gas Offices, Barnoldswick,
June 22, 1899.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to the CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 4th day of July next, and WILL BE RE-OPENED immediately after the Half-Yearly General Meeting of the Company, to be held on the 4th day of August next.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 23, 1899.

SANDELL'S

Gas Companies' Account Books.

The Gas Companies' Expenditure Journal.

With Printed Headings and Analyzing Guide, for keeping the Expenditure of Gas Companies upon the easiest and most correct method, and in accordance with the provisions of the Gas-Works Clauses Act of 1871. Size: 16¾ in. by 17½ in.

Price: Half-bound, Cloth Sides, Two Quires, 36s.; Three Quires, 45s.

This Book and its predecessor (on the same principle, have been in use since 1867.

The Gas Companies' Rental-Book.

A companion Book to above, with Printed Headings and Illustration, for keeping the Consumers' Accounts with Gas Companies on labour-saving principles. Compact and Precise. A boon to Secretaries, Accountants, and Auditors.

Size and Price as above.

Consumers' Names are only written once in every two years by this system.

The Analyzed Wages Book.

Compiled for use in conjunction with the above Expenditure Journal, with Printed Headings, and adapted to the form for making up the Annual Accounts under the provisions of the Gas-Works Clauses Act, 1871. Size: 15 in. by 10½ in.

Price: Half-bound, Cloth Sides, Two Quires, 15s.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

THE NORTH WARWICKSHIRE WATER CO.,

Incorporated by the North Warwickshire Water Act, 1898.

Issue at Par of 3000 ORDINARY SHARES OF £10 EACH

(Ranking for Dividend up to Ten per Cent.)

PAYMENTS: On Application, 20 per cent.; One Month after Allotment, 20 per cent.; and the Balance in calls of not exceeding 20 per cent., at intervals of not less than Two Months.

THE LIABILITY ON THE SHARES IS LIMITED.

The usual Borrowing Powers are limited by Section 11. to one-fourth of the Capital fully paid up.

Bankers: LLOYDS BANK, COVENTRY.

The List will OPEN on MONDAY, June 26th, and will CLOSE on or before FRIDAY, June 30th, 1899.

The Directors give notice that they are prepared to receive applications at par for 3000 Ordinary Shares of £10 each, ranking for Dividend up to 10 per cent., being part of the Company's authorized Capital under Section 9 of the North Warwickshire Water Act, 1898.

The Company's works were officially opened by the Chairman of the Foleshill Rural District Council on the 10th inst. (a report of the proceedings accompanies the prospectus).

The preamble of the Bill states: "Whereas there is no proper or adequate supply of water to the parish of Foleshill and adjacent parishes and places in the county of Warwick."

Under Section 5: "The limits of this Act for the supply of water shall be the parishes of **Foleshill, Exhall, Bowe, Wyken, Stoke, Binley, Keresley, and Corley all in the county of Warwick.**"

The application for the Company's Act received the unanimous support of the Foleshill Rural District Council and other Local Authorities in the district, passing both Houses of Parliament as an unopposed Bill. The Company's area of supply, which is an important one, has a population of upwards of 17,000, with a rateable value of over £50,000; the population has increased more than 23 per cent. since the census of 1891, and is now advancing at an even more rapid rate. A part of the district being very urgently in want of a proper water supply, the following Clause was inserted in the Company's Act of Parliament:—

"If at any time after the expiration of eighteen months as regards the roads, streets, and areas respectively, coloured pink upon the plan and of three years as regards the remainder of the area within the limits of supply from the commencement of this Act, the Company are not furnishing, or prepared on demand to furnish, a sufficient and constant supply of water in accordance with the provisions of this Act, the Local Authority of the district in which such roads, streets, and areas are respectively situate may provide a supply in the whole or any part of their district within the limits of supply in accordance with the provisions of the Public Health Act, 1875, or any company, body, or person may apply for an Act of Parliament or Provisional Order for the purpose of supplying water in any part of such district not sufficiently supplied by the Company as if in either case there were no Company authorized by this Act to supply water therein."

A contract dated 24th of February, 1899, was entered into by the Company for the construction of works, and under this contract upwards of 12 miles of trunk and distributory mains have been laid, and water is now being supplied; the remainder of the work is being rapidly proceeded with. Applications have already been received for upwards of eight hundred domestic and trade supplies, and of these more than six hundred have already been connected to the mains. Further applications are being received daily.

Under Section 7: Power is given to the Corporation of Coventry should the boundary of the City be so altered as to include any portion of the Parishes of Foleshill and Stoke to purchase that part of its undertaking in accordance with the provisions of the Lands Clauses Acts.

"Provided that the arbitrators or their umpire to be appointed in pursuance of the Lands Clauses Acts shall not, in determining the price to be paid by the Corporation, make any allowance for or in respect of prospective value of the portion of the undertaking to be acquired by the Corporation to accrue after the year one thousand nine hundred and ten."

"The power of purchase herein granted shall be exercised only in the event of and as to any extension of the City boundaries being duly authorized as aforesaid," application for which is now before Parliament.

It will thus be seen that the interests of the Shareholders will be amply protected, in the event of the circumstances contemplated by the section arising.

The Company have obtained an excellent supply of water from their well, recently constructed, and situated in the rural district of Corley—a distance of about three miles from Foleshill. The quantity available from this service is approximately 250,000 gallons in 24 hours, and the purity which would be expected from this selected site, is testified to by Mr. Otto Hehner, Public Analyst for Nottinghamshire, who, in his report on the sample received from the Company's well, states:—

"This is a water of great organic purity; there is no indication whatever of sewage pollution."

The District will be supplied by gravitation from the high service reservoir, a section of which is completed and in operation. A second pumping-station is authorized at Keresley; and it is proposed to sink a second well and construct auxiliary works on this site. The Directors are advised that, when these are completed, the supply of water at the Company's disposal will reach 500,000 gallons per day.

The Directors feel satisfaction in pointing out the rapid progress that has been made with the works, and also the large number of customers already secured. With the considerable population yet to be supplied, and the admittedly great demand for water in the District, there is no doubt that these Shares offer an unusually sound investment, with the prospect of obtaining an early return in dividends.

A plan is enclosed with the prospectus showing the Company's authorized area of supply, mains, and sites of pumping-stations and reservoir. From this will be seen the close proximity of the Company's area to the City of Coventry, also the special facilities of communication in the district, including the Electric Tramway Systems, the three passenger and two goods stations of the London and North-Western Railway Company, and the Coventry and Oxford Canal.

A considerable portion of the district is of an industrial character. Amongst the important works may be mentioned, the tramway electric power station, silk, woollen, hosiery, and elastic factories, iron foundries and stamping works, cycle factories, brewing, steam and other laundries, and brick and tile manufactories. The Coventry Corporation also contemplate the construction of extensive Gas-Works in Foleshill, for which they have recently obtained Parliamentary powers. In the north and east of the district are coal mines, and the parish of Stoke is a residential suburb of Coventry.

As an illustration of the value of local water companies' shares as investments may be mentioned the following:—

Stourbridge Water-Works Company, Limited, Original 8 per cent. £10 Shares (A, B, & C)—Present Price, £19; Premium, 90 per cent.

Staffordshire Potteries Water-Works Company, Consolidated Ordinary (£100) Stock—Present Price, £214; Premium, 114 per cent.

A Form of Application for Shares is annexed hereto. Where no allotment is made, the deposit will be returned in full; and in case of a partial allotment, the balance will be applied towards the subsequent instalments. If default be made in payment of any instalment at its proper date the deposit and instalments previously paid will be liable to forfeiture.

Prospectuses and Forms of Application may be obtained at the Company's offices; or of their Bankers, Messrs. Lloyds Bank, Limited, Coventry; and at their London Office, Lombard Street, E.C., and Branches; of Messrs. Baker, Lees, & Co., Solicitors, 54, Parliament Street, Westminster, at whose Office the before-mentioned contract and Analyst's Report, and the Company's Act, can be inspected; or of Mr. W. Vaughan Best, Solicitor, Coventry.

Applications for Shares should be made on the annexed form, and forwarded to the Company's Bankers with the amount of deposit.

DIRECTORS.—FREDERICK MILLER, Director of the Crowborough District Water Company, and the Cranbrook District Water Company; SIDNEY DENNIS, Director of the Barton-upon-Humber Water-Works Company; RICHARD BARNES, Director of the Cobham Gaslight and Coke Company, Limited; E. T. GOULD, Director of the Cranbrook District Water Company; E. R. PAINTER, Director of the Crowborough District Gas Company, Limited, and the Selsey Gas and Lighting Company, Limited.

BANKERS.—LLOYDS BANK, Coventry.

SOLICITORS.—BAKER, LEES, & CO., 54, Parliament Street, Westminster; W. VAUGHAN BEST, 2, Warwick Row, Coventry.

ENGINEERS.—JOSEPH QUICK & SON, M.Inst.C.E., Great George Street, Westminster.

AUDITORS.—W. B. KEEN & CO. (Chartered Accountants), 3, Church Court, Old Jewry, E.C.

SECRETARY.—L. H. DEROUET.

DISTRICT MANAGER.—P. H. BETTLE.

LOCAL OFFICE.—FOLESHILL, near COVENTRY.

LONDON OFFICES.—4, TOKENHOUSE BUILDINGS, BANK OF ENGLAND.

LONDON, *June*, 1899.

This Form may be used.

THE NORTH WARWICKSHIRE WATER COMPANY

APPLICATION FOR SHARES.

(To be retained by the Bankers, Lloyds Bank.)

To the Directors of THE NORTH WARWICKSHIRE WATER COMPANY.

GENTLEMEN,

Having paid to the Company's Bankers the sum of £.....

being a deposit of £2 per Share on application for.....Shares of £10 each in the above Company, I request you to allot me that number of Shares, and I agree to accept the same or any less amount allotted to me, and I authorize you to place my name on the Register of Members in respect of such Shares. In the event of a fewer number of Shares being allotted to me, the balance to be applied towards the subsequent instalments.

Name in full.....

Address in full.....

Occupation.....

Date.....

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

LOWESTOFT WATER AND GAS COMPANY.

500 £10 (FULLY PAID) ADDITIONAL ORDINARY SHARES.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Wednesday, June 28, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

SOUTHEND GAS COMPANY.

£10,000 OF FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Wednesday, June 28, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

SOUTHEND WATER-WORKS COMPANY

500 £10 SHARES.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, E.C., on Wednesday June 28, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

GUILDFORD GASLIGHT AND COKE COMPANY.

£5000 OF ORDINARY STOCK,

Ranking for a Standard Dividend of 5 per cent. per annum subject to the Sliding Scale; the Dividend on similar Stock in the Company having for several years past been at this rate, and paid free of Income-Tax.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION at the Mart, E.C., on Wednesday, July 5, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors.

WATFORD GAS AND COKE COMPANY.

£3500 "C" CAPITAL STOCK,

Ranking for a Standard Dividend of 7 per cent. subject to the Sliding Scale, the last Dividend on the Company's "C" Capital Stock having been at the rate of 9 per cent. per annum.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Wednesday, July 5, at Two o'clock, in Lots.

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NITRATE of Thorium and Cerium. FABRIK CHEMISCHER PRAEPARATE VON STHAMER, NOACK, AND CO., HAMBURG.

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PRICES REDUCED.

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Illuminating Power	16 7/10 Stand. Sperm. Candl.
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Ash	Under 1 per Cent.
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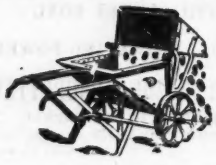

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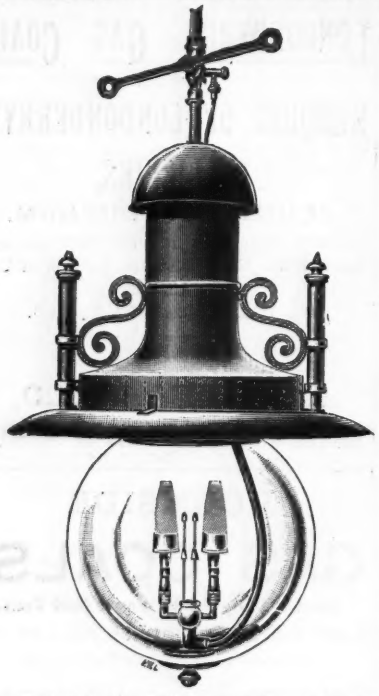

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ANALYSIS.

Yield of Gas per Ton. .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

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Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

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Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

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For Prices and Analysis, apply as above.

CAUTION! CAUTION! CAUTION!

THE WARNING of THE WELSBACH INCANDESCENT GAS-LIGHT COMPANY, LIMITED, against Buying, Selling, or Using—

DAYLIGHT COMPANY'S MANTLES,

SUNLIGHT COMPANY'S WHITE MANTLES,

has been proved to be justified so far as the Daylight Mantle is concerned, by the recent

JUDGMENT

of Mr. JUSTICE BYRNE, whereby the

DAYLIGHT COMPANY'S MANTLE

is pronounced an

INFRINGEMENT OF THE COMPANY'S PATENTS.

Having disposed of the Daylight Company, the Welsbach Incandescent Gas-Light Company will, notwithstanding all assertions to the contrary, now push on with the ACTION AGAINST the **NEW SUNLIGHT INCANDESCENT COMPANY, LIMITED,** and they are advised that a similar Judgment will be obtained against that Company.

ALL DEALERS and the **PUBLIC** are **CAUTIONED** against **BUYING, SELLING,** or **USING**

SUNLIGHT COMPANY'S WHITE MANTLES,

DAYLIGHT COMPANY'S MANTLES,

as well as similar Mantles imported from the Continent and hawked about the Country.

☞ **USERS are EQUALLY LIABLE with DEALERS.**

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CATALOGUE SENT ON APPLICATION.

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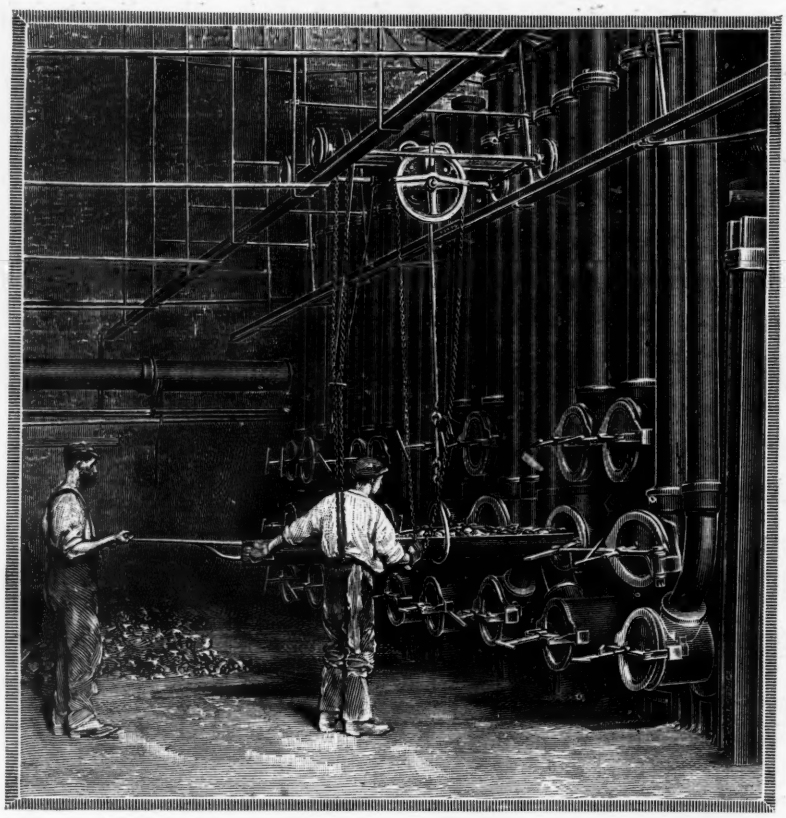

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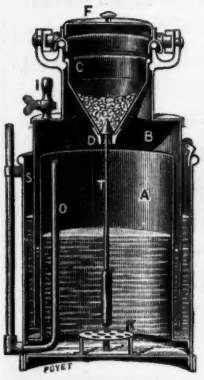

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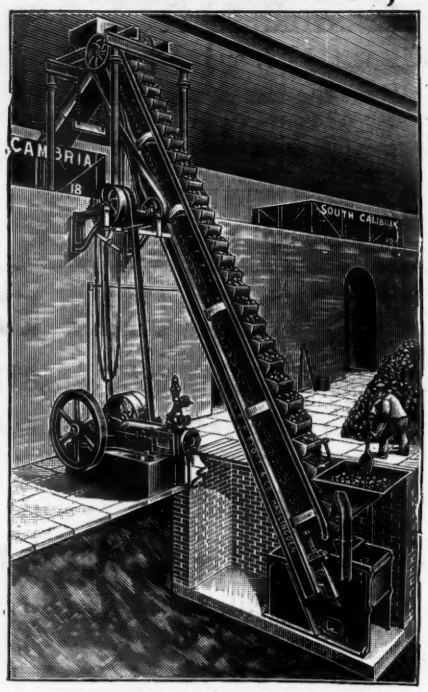

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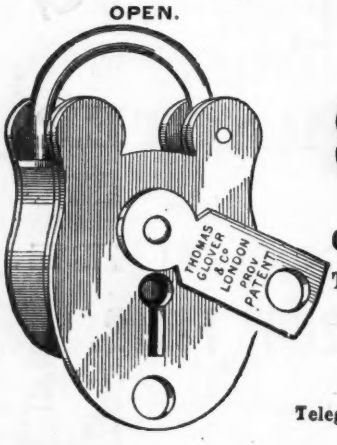

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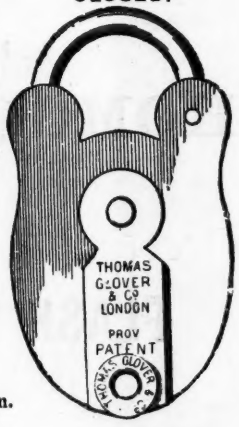

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Strongest and Pleasantest Colour.

These are INTERCHANGEABLE on same Burner.

BURNERS WITH CHIMNEYS.
Cheapest in the Market.

CHIMNEYLESS BURNERS.
Cheapest, Simplest, and Most Efficient.

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Only Efficient System.

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We give with every Mantle sold an absolute indemnity to both seller and user against all molestation on this account.

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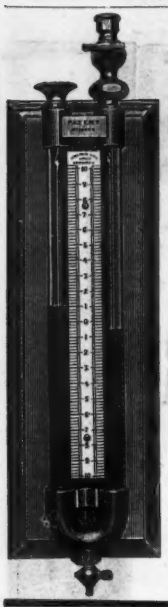

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Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.

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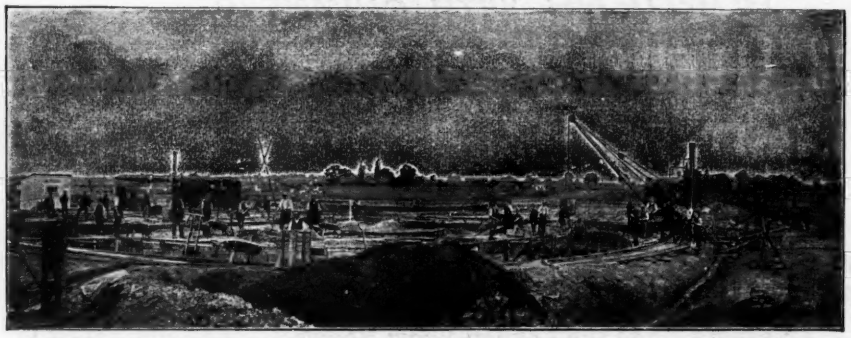

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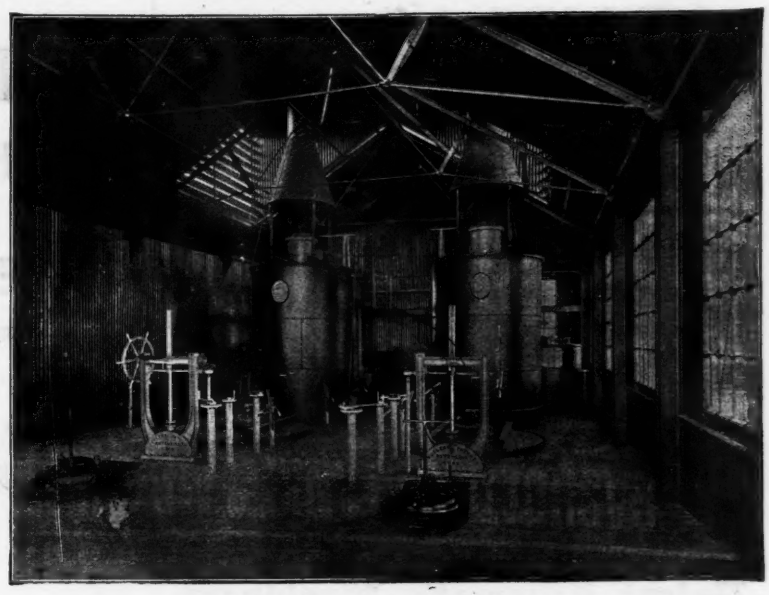
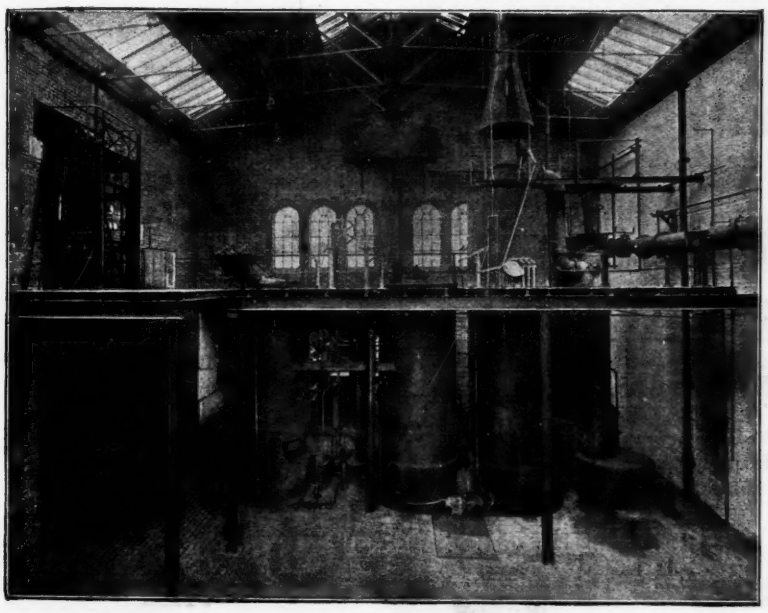


Water-Gas Plant at Southall.



Water-Gas Plant at Folkestone.

Carburetted Water-Gas Installations.

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ADOPTED FOR
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GASHOLDERS.

OIL-TANKS.

EVERY DESCRIPTION OF
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MANUFACTURERS OF
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SOCKET-PIPES FOR GAS OR WATER PURPOSES.
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Patent Automatic Machinery
FOR
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Bellows made to inflate a 48-inch Bag under One Minute.

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Special Air Tubing made for Gas Companies.

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ON THE CONTINUOUS SYSTEM
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Established 1836.

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Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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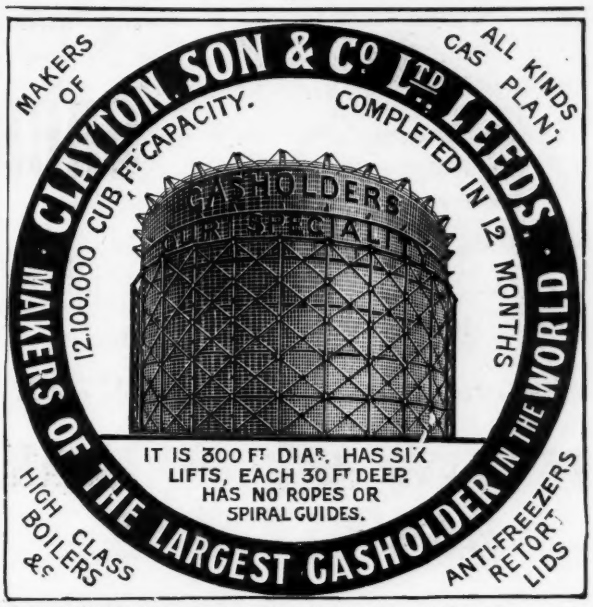
IMPROVED GAS-METER PERSIANS.

UNSURPASSED FOR QUALITY AND VALUE.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SPECIALITY
IT IS 300 FT DIAM. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
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With this Superheater, the **Temperature of the Liquor can be raised to 190° Fahr. before entering the Still** by means of the Waste Gases only; **Steam and Fuel are saved; the capacity of the Plant is increased; the cheapest unrefined acid can be used; and less condensing power is required.**

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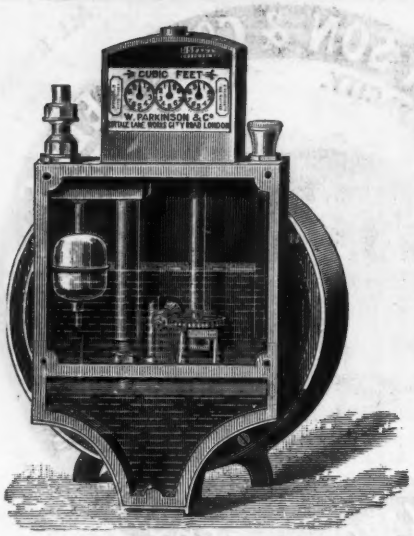

ORDINARY WET METERS

IN CAST-IRON CASES.

Work with very little friction. Will stand very high pressures. Cannot possibly be shut off by sudden increase of pressure, the Float being affected by Outlet Gas only. Allow for loss of water by evaporation without materially affecting the registration or shutting off the gas. Unexcelled for simplicity of construction, excellence of workmanship, or accuracy in registration.

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The Slow-Spoon Compensator has been in extensive use for many years; it maintains an unvarying water-line without appreciable friction, and provides a large reserve of water. The Float arrangement allows sudden or excessive pressure on the Inlet without affecting the working of the Meter or extinguishing the Lights.

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These Meters are unsurpassed for accuracy of registration. The cases are made of the best Charcoal Tin Plates; and each part of the Meter is stamped by special Machinery to ensure uniformity and exactness in construction. The Diaphragms are all of the best Persian Sheep Skins, carefully selected, and the brasswork and smaller fittings are of superior workmanship.

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[See also Advt. p. 1716.

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